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PROGRESS REPORT 2

GEOTECHNICAL DATA GATHERING PROJECT
HYDROLOGIC PROGRAM
SECTION 1.2

APPENDIX

APRIL 15, 1975

TO

AREA OIL SHALE SUPERVISOR
UNITED STATES GEOLOGICAL SURVEY

By
WRIGHT WATER ENGINEERS, INC.
For
Gulf Oil Corporation
and
Standard Oil Company (Indiana)

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PROGRESS REPORT 2

GEOTECHNICAL DATA GATHERING PROJECT
HYDROLOGIC PROGRAM
SECTION 1.2

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APPENDIX

APRIL 15, 1975

TO

AREA OIL SHALE SUPERVISOR
UNITED STATES GEOLOGICAL SURVEY

By
WRIGHT WATER ENGINEERS, INC.
For
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and
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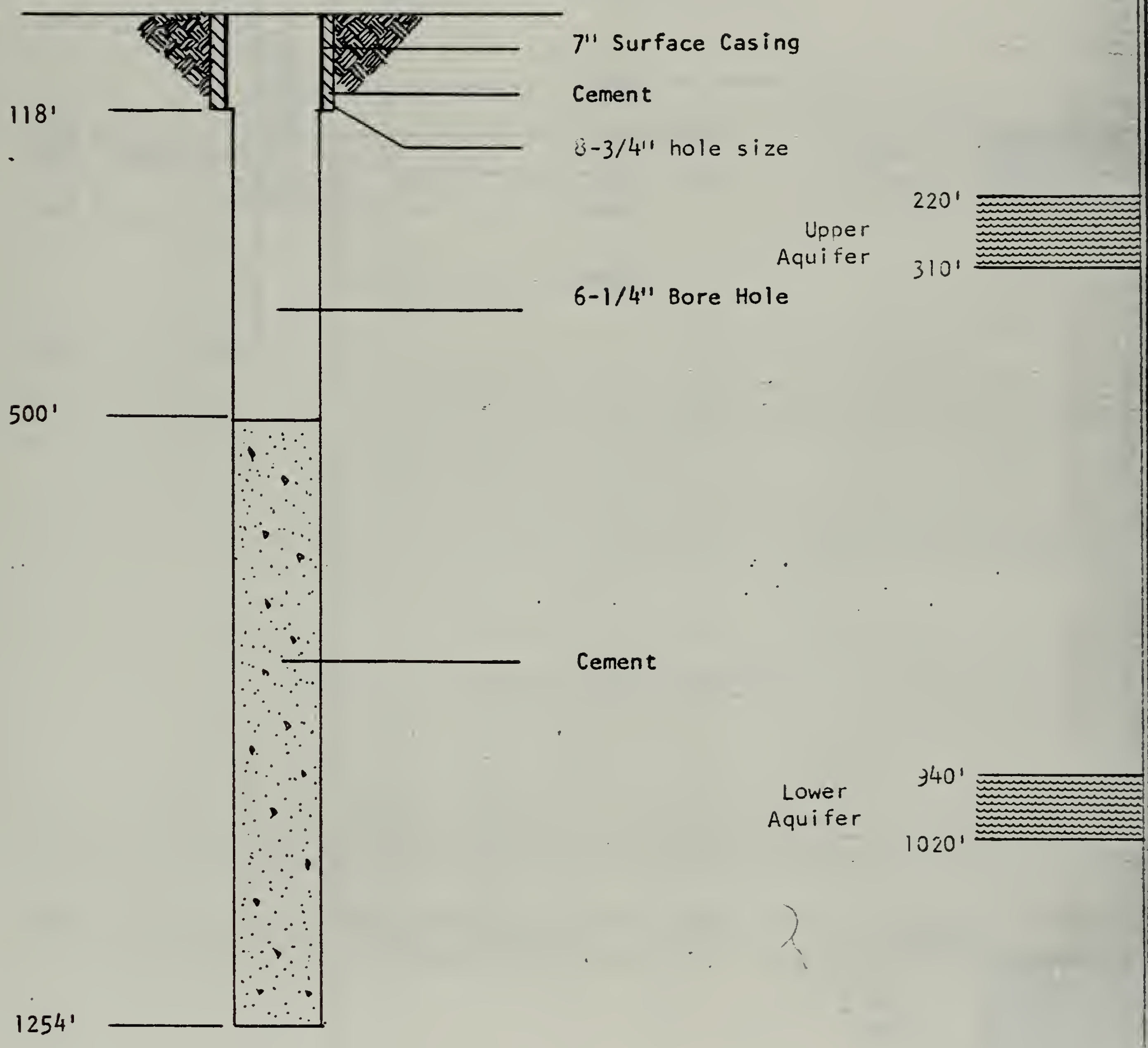


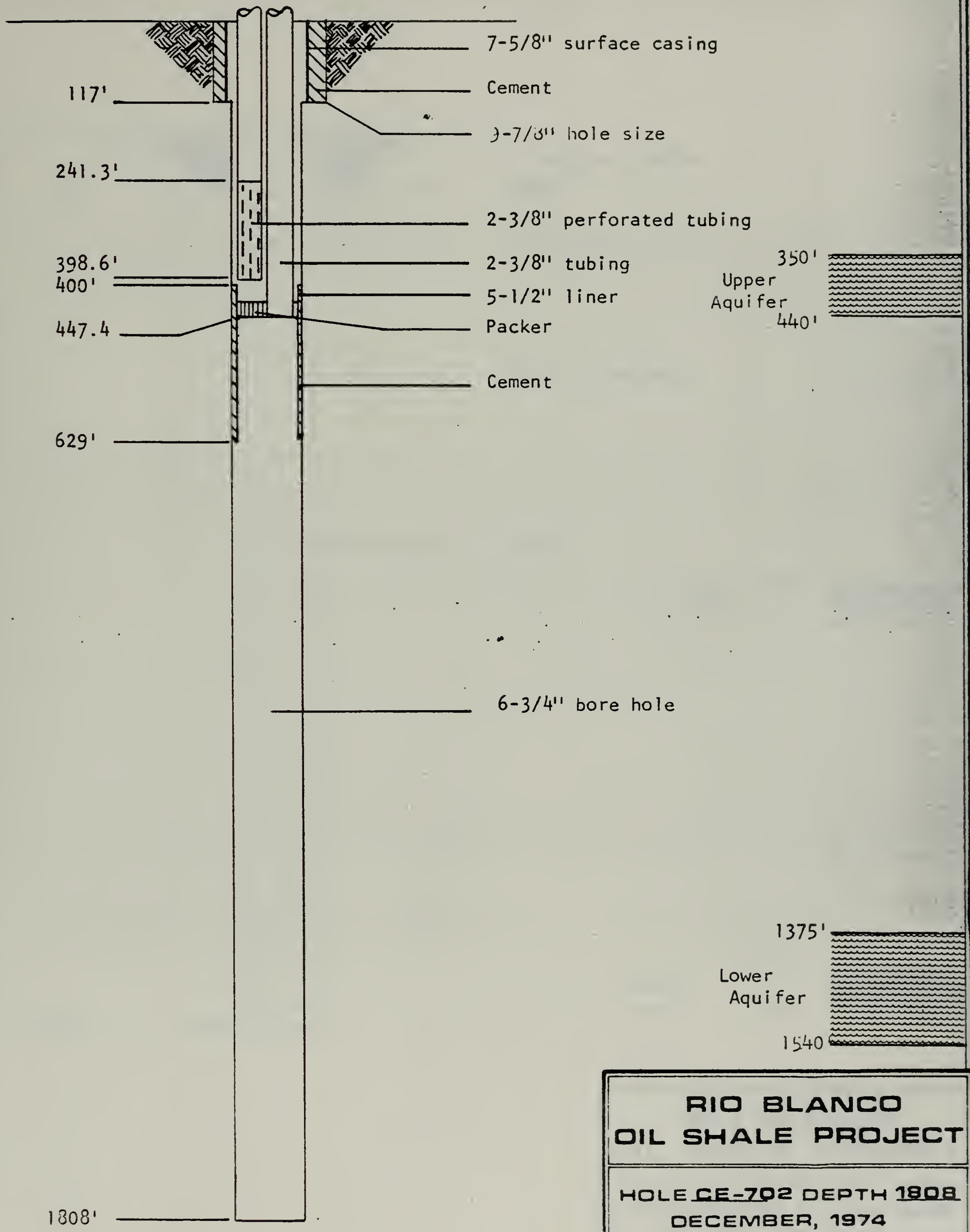
RIO BLANCO
OIL SHALE PROJECT

HOLE CE-701 DEPTH 1254
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 802

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7



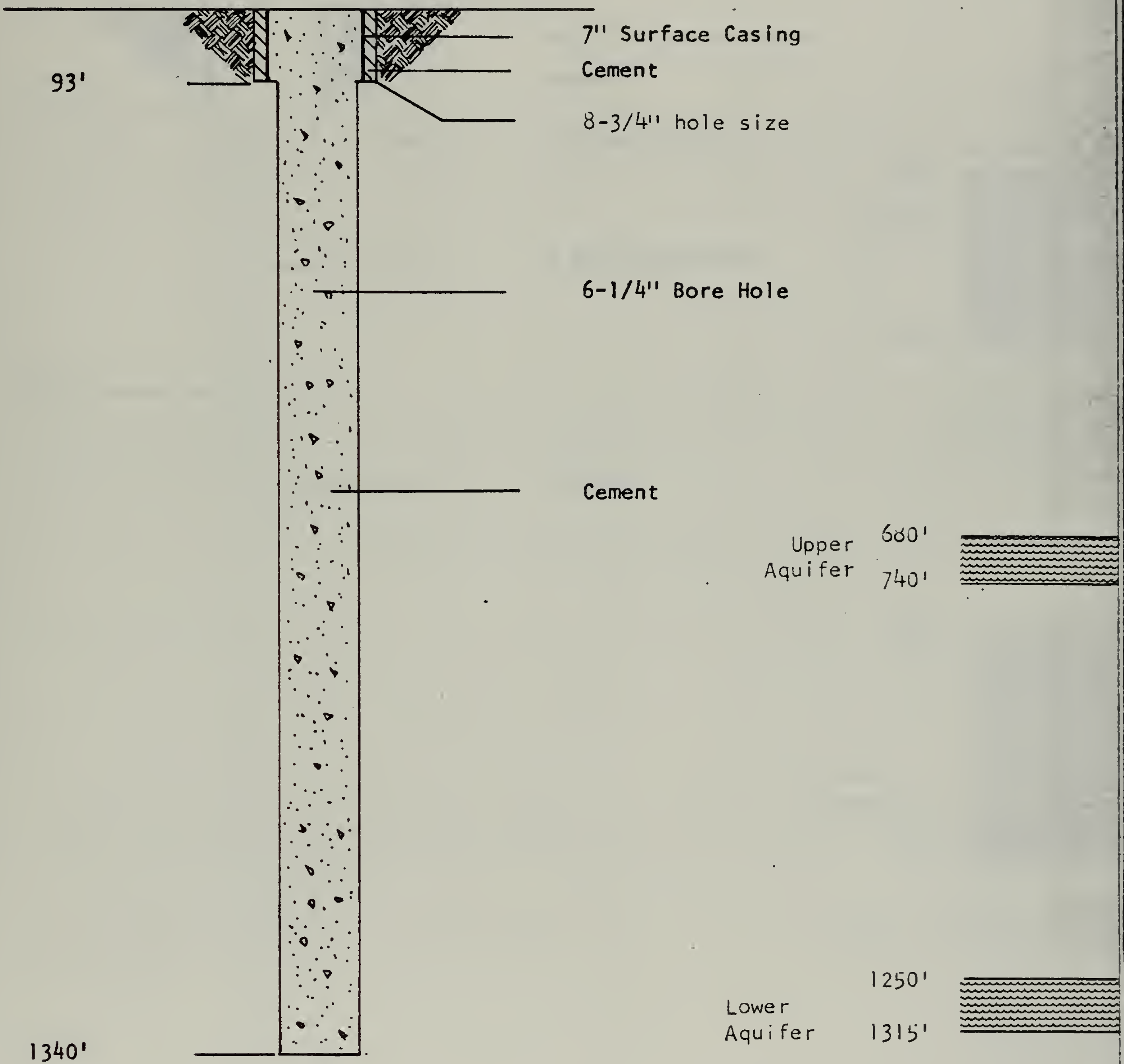
RIO BLANCO
OIL SHALE PROJECT

HOLE CE-702 DEPTH 1808
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1'-1-0"

FIG. 7



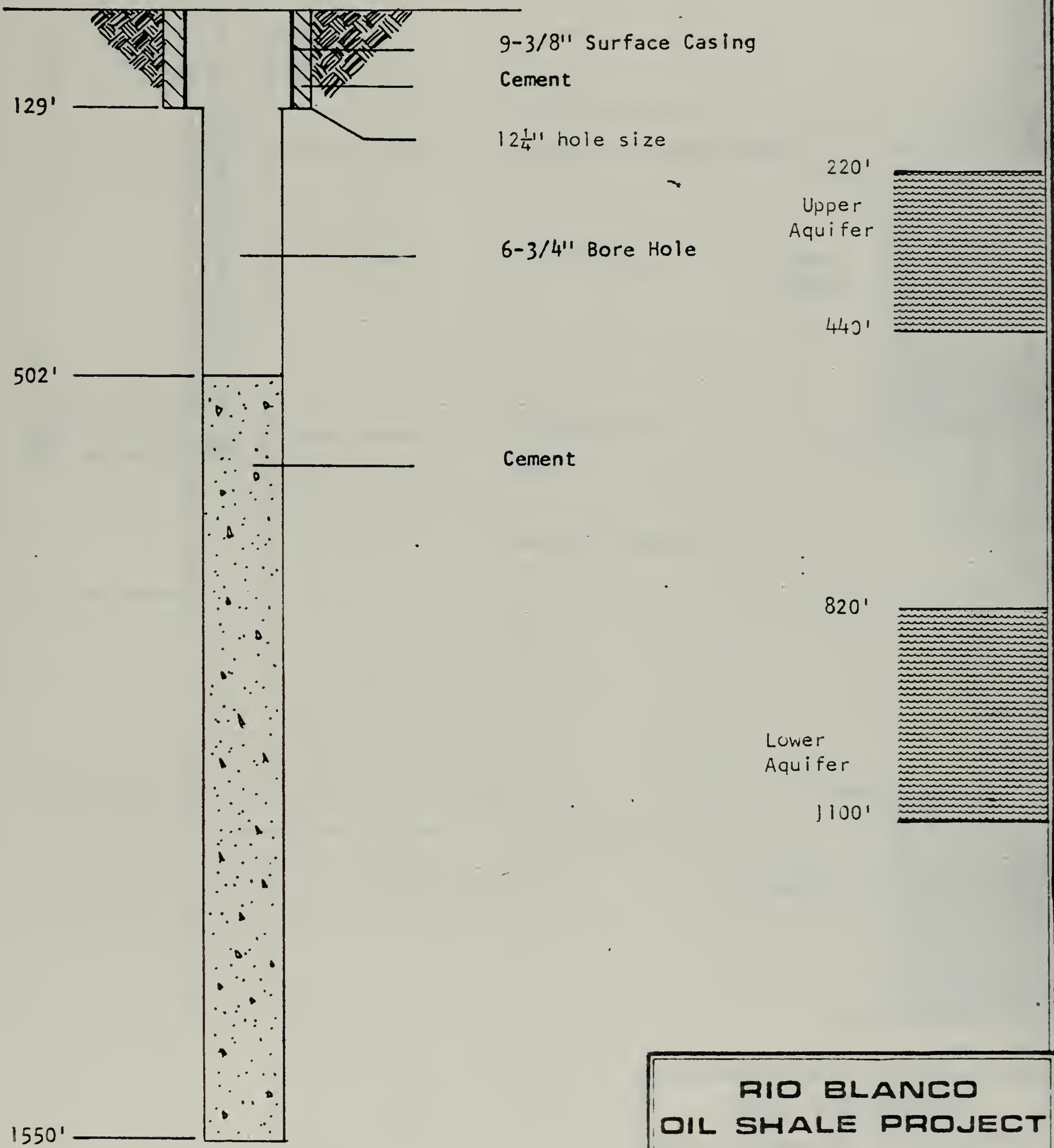
RIO BLANCO
OIL SHALE PROJECT

HOLE CE-703 DEPTH 1340
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE
HORIZONTAL SCALE

FIG. 7



VERITICAL SCALE 1"-200'

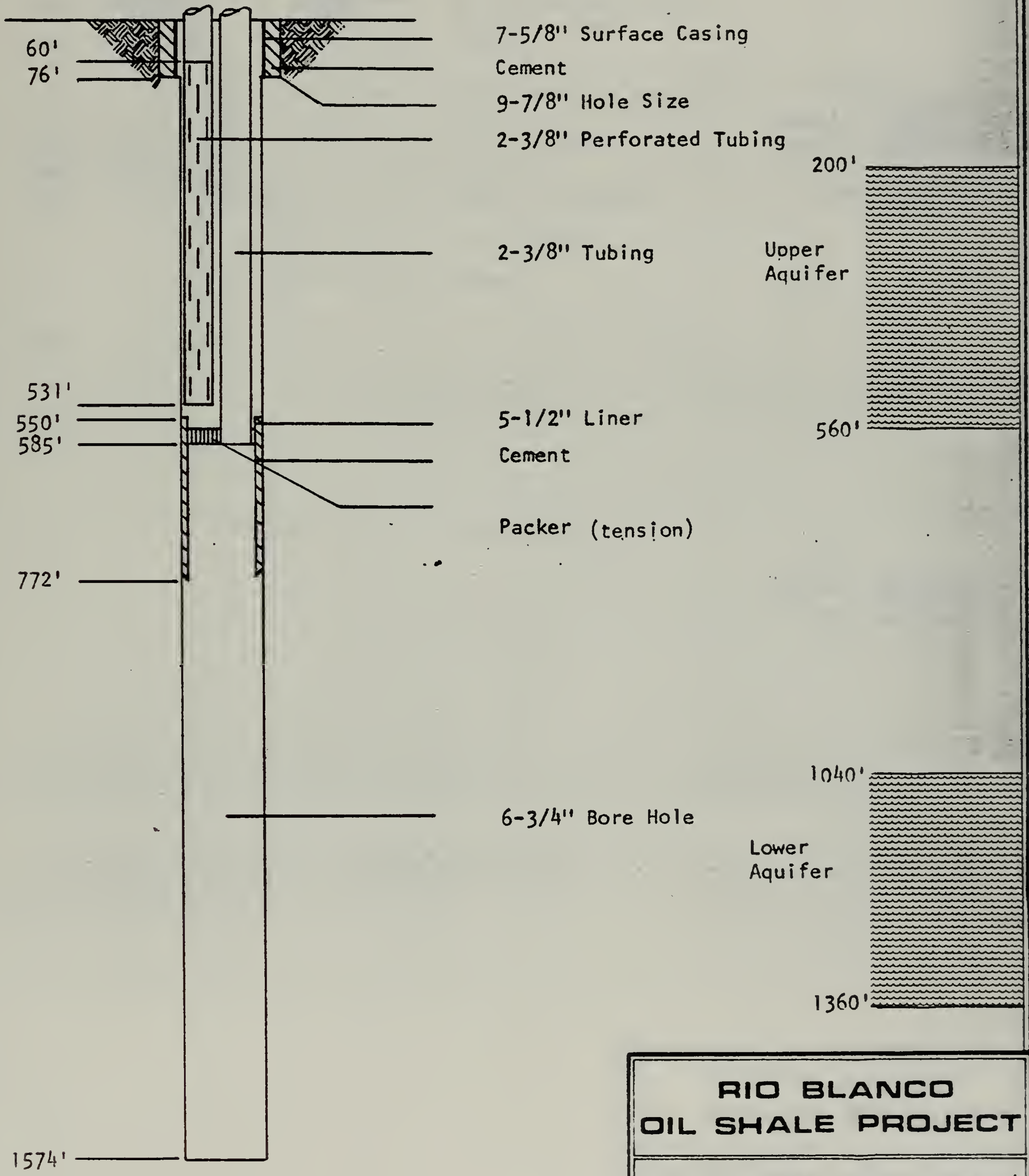
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

RIO BLANCO
OIL SHALE PROJECT

HOLE CE-705A DEPTH 1550
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211



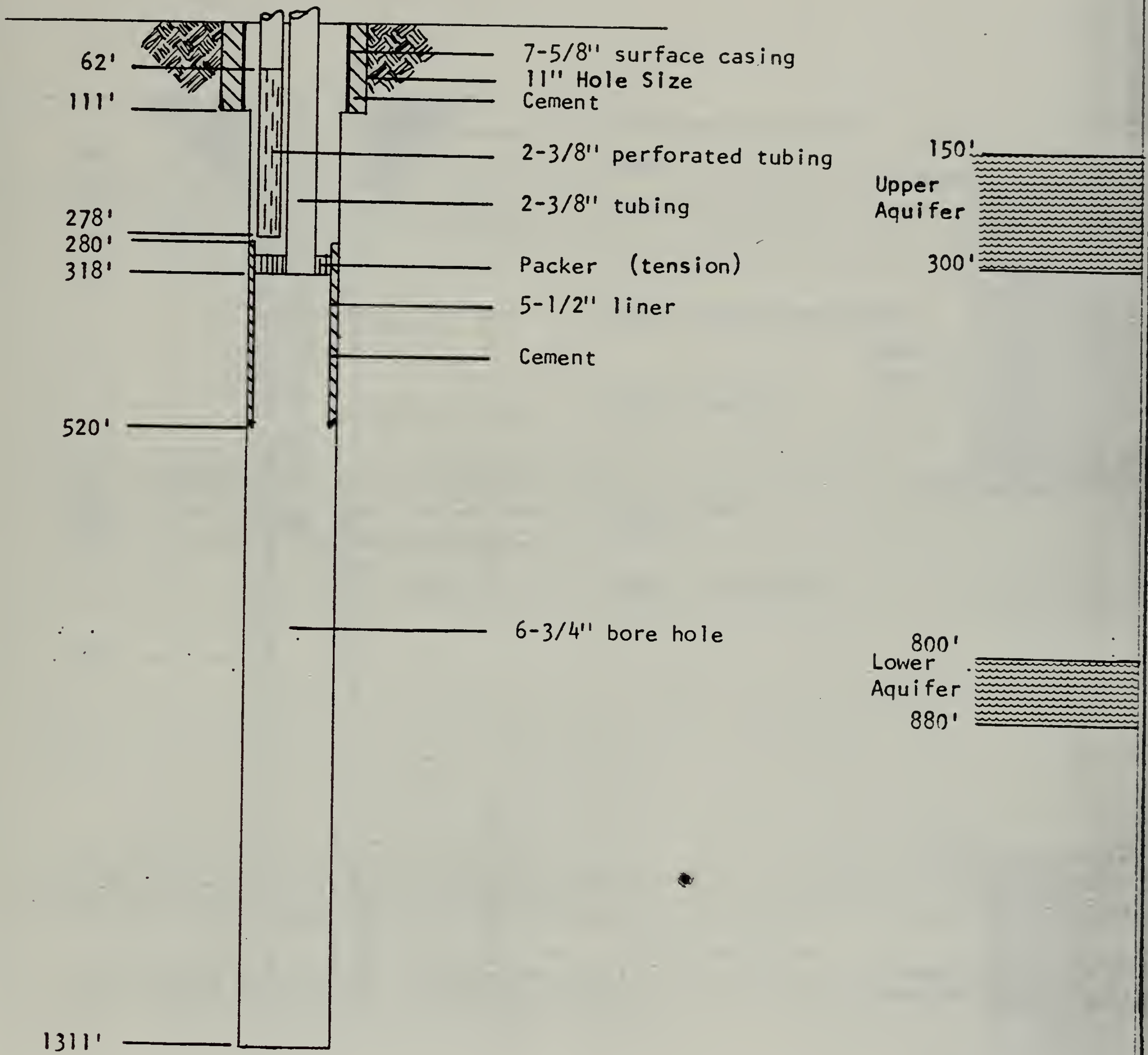
VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

RIO BLANCO OIL SHALE PROJECT

HOLE CE-707 DEPTH 1574'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211



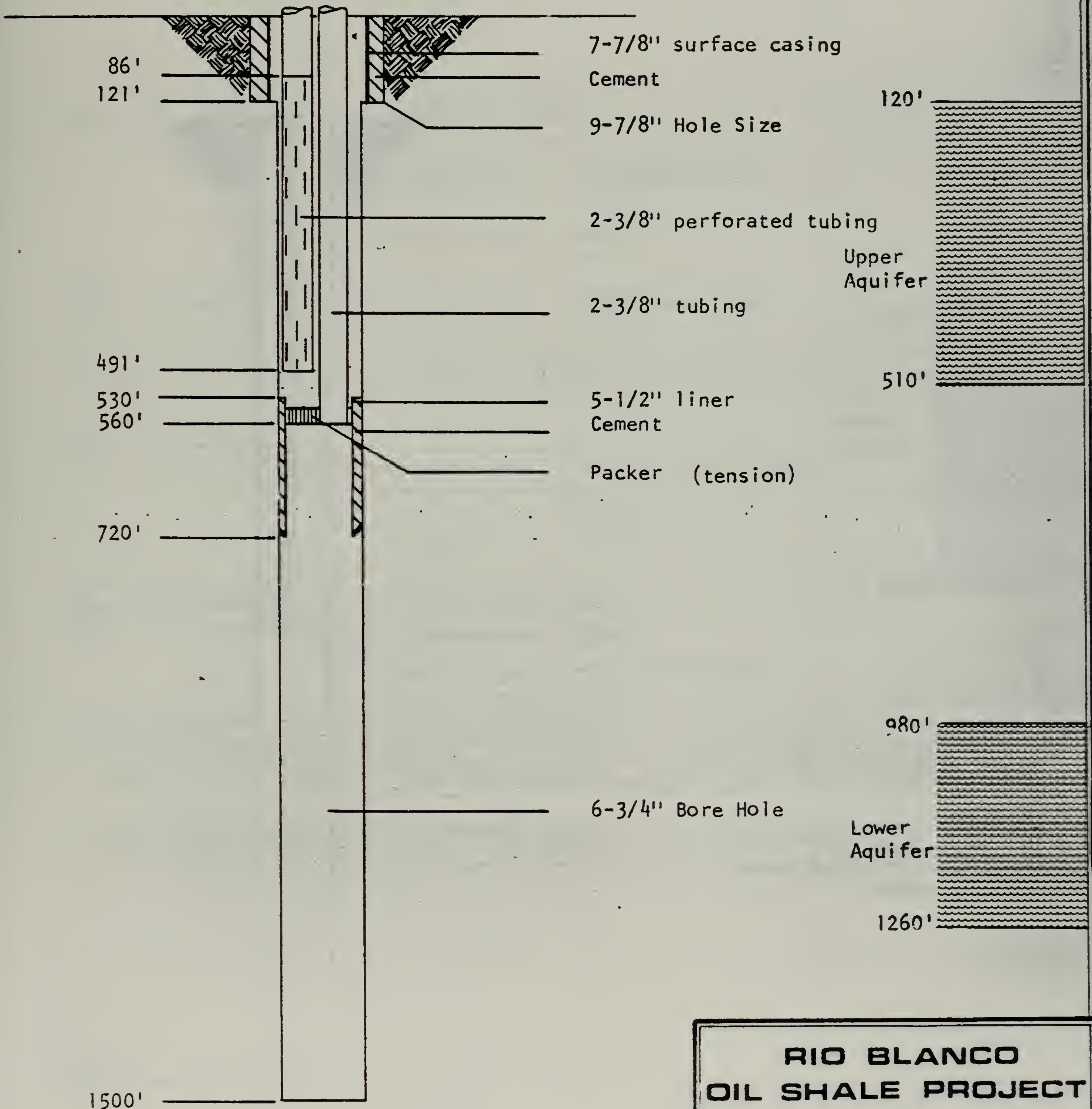
RIO BLANCO
OIL SHALE PROJECT

HOLE CE-708 DEPTH 1311
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
[illegible]
[illegible]

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7



VERITICAL SCALE 1"-200'

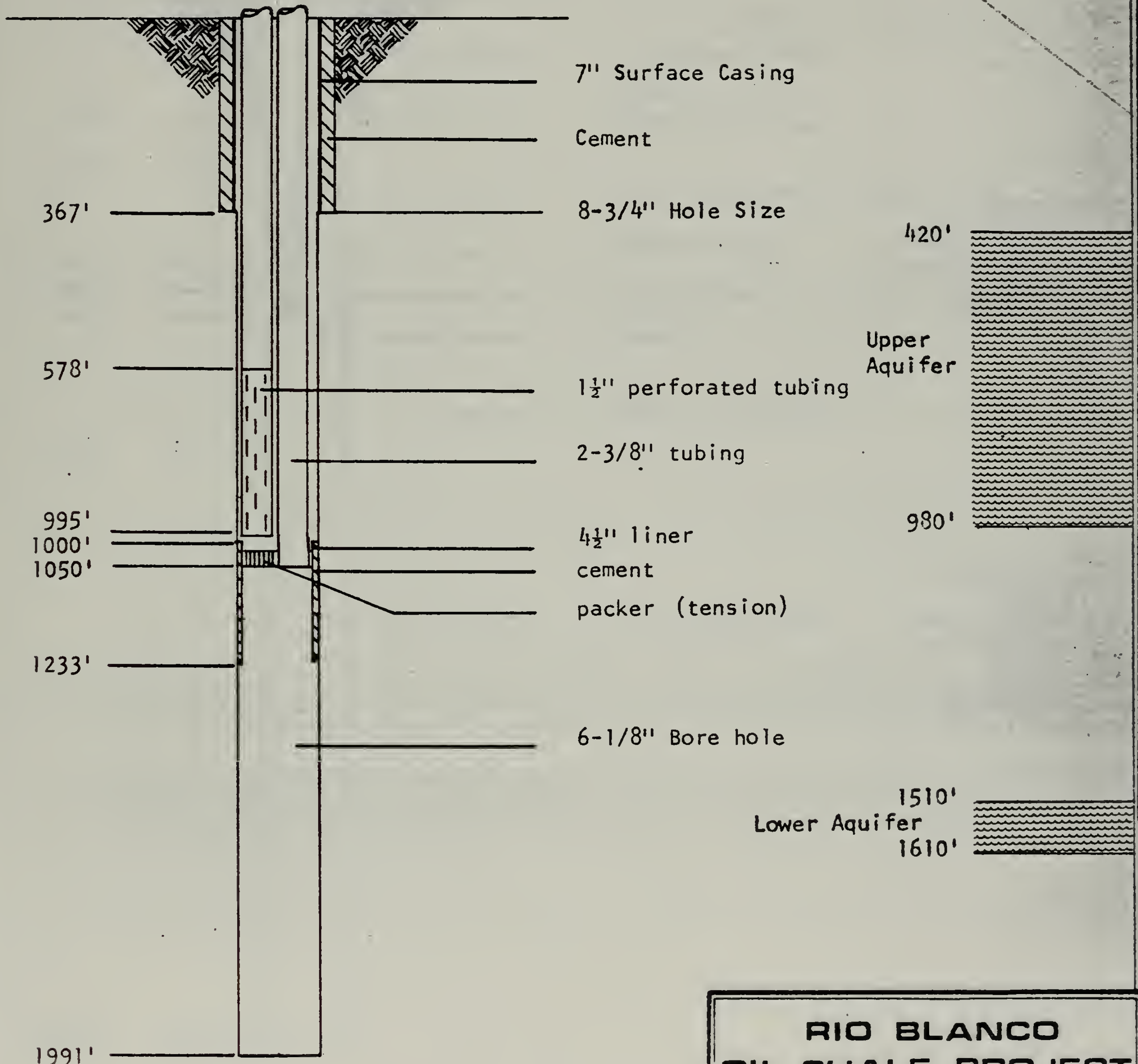
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

RIO BLANCO
OIL SHALE PROJECT

HOLE CE-709 DEPTH 1500'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211



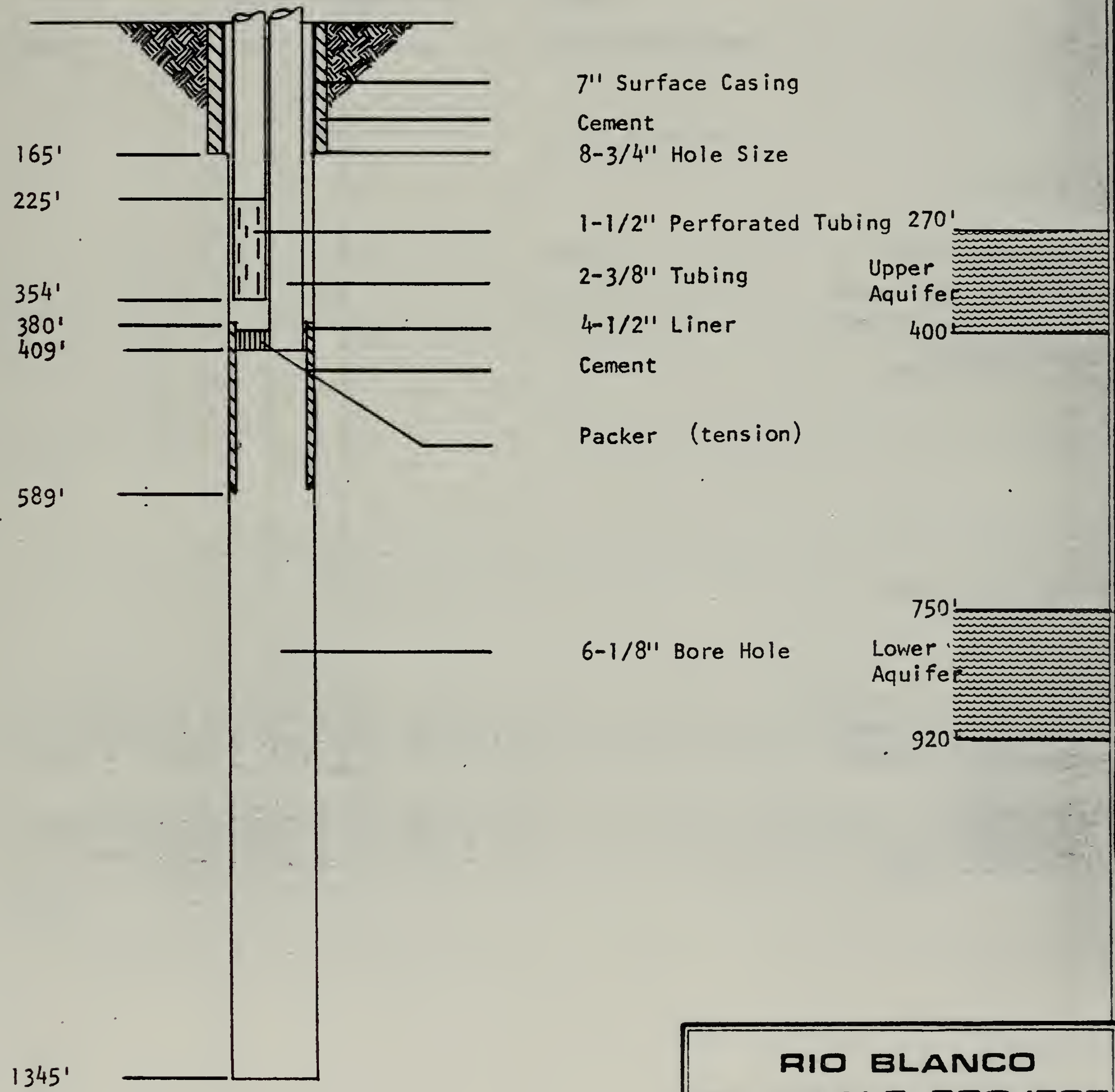
RIO BLANCO
OIL SHALE PROJECT

HOLE AM-2A DEPTH 1991'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC.
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"- 300'
HORIZONTAL SCALE 1"-1'0"

FIG. 7



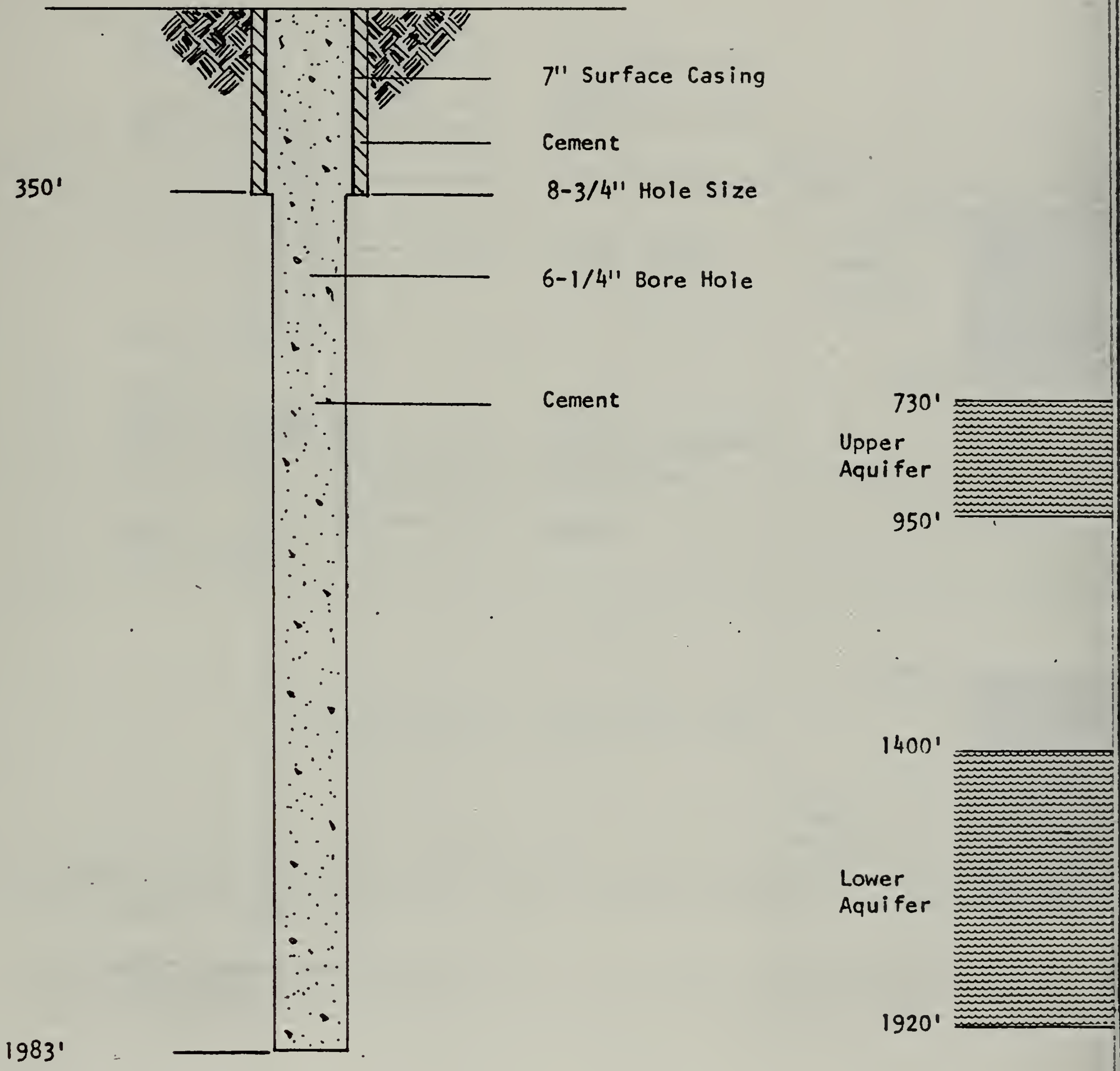
RIO BLANCO
OIL SHALE PROJECT

HOLE AM-3 DEPTH 1345'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC.
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7



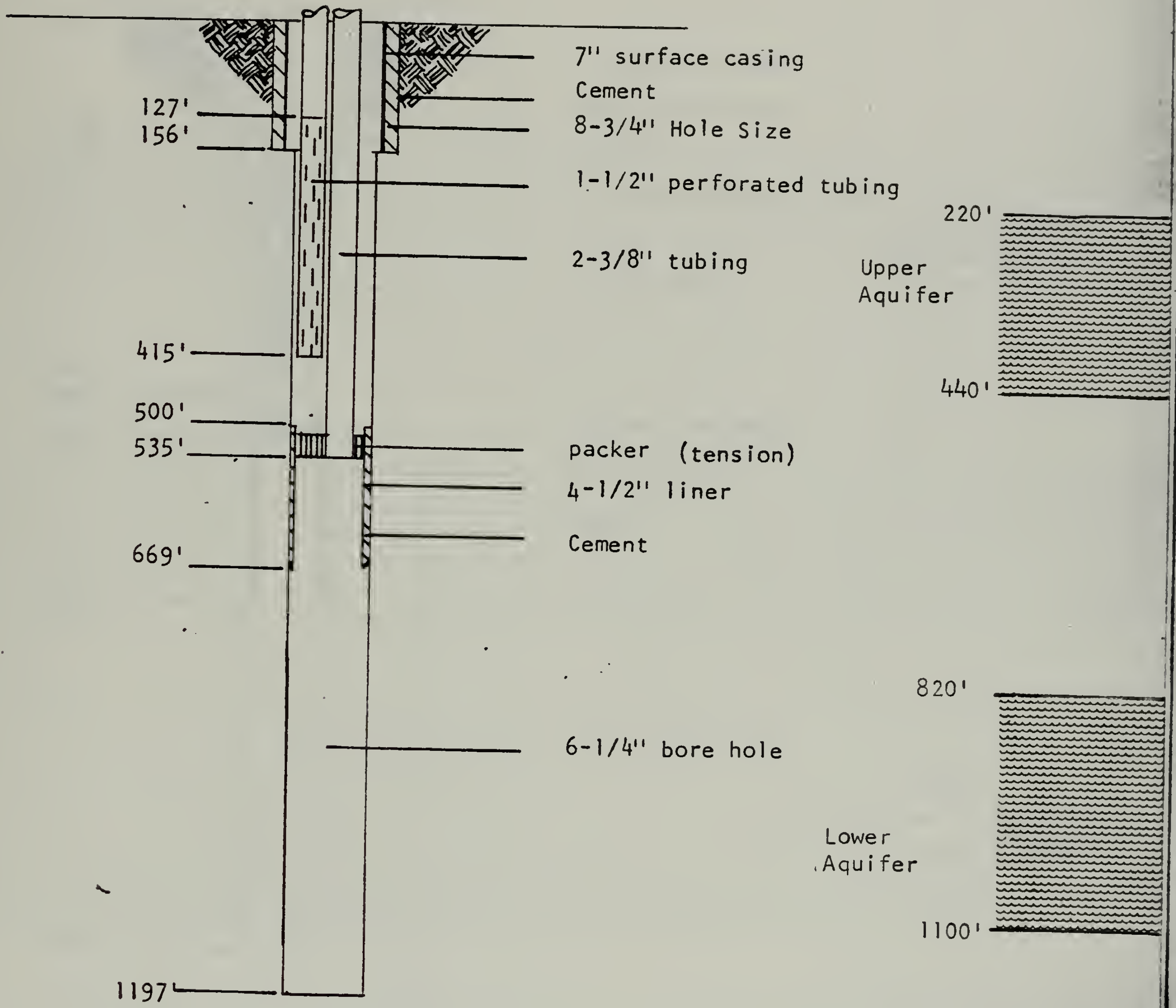
RIO BLANCO
OIL SHALE PROJECT

HOLE AM-4 DEPTH 1983
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
[illegible]
[illegible]

VERITICAL SCALE 1"-300'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7



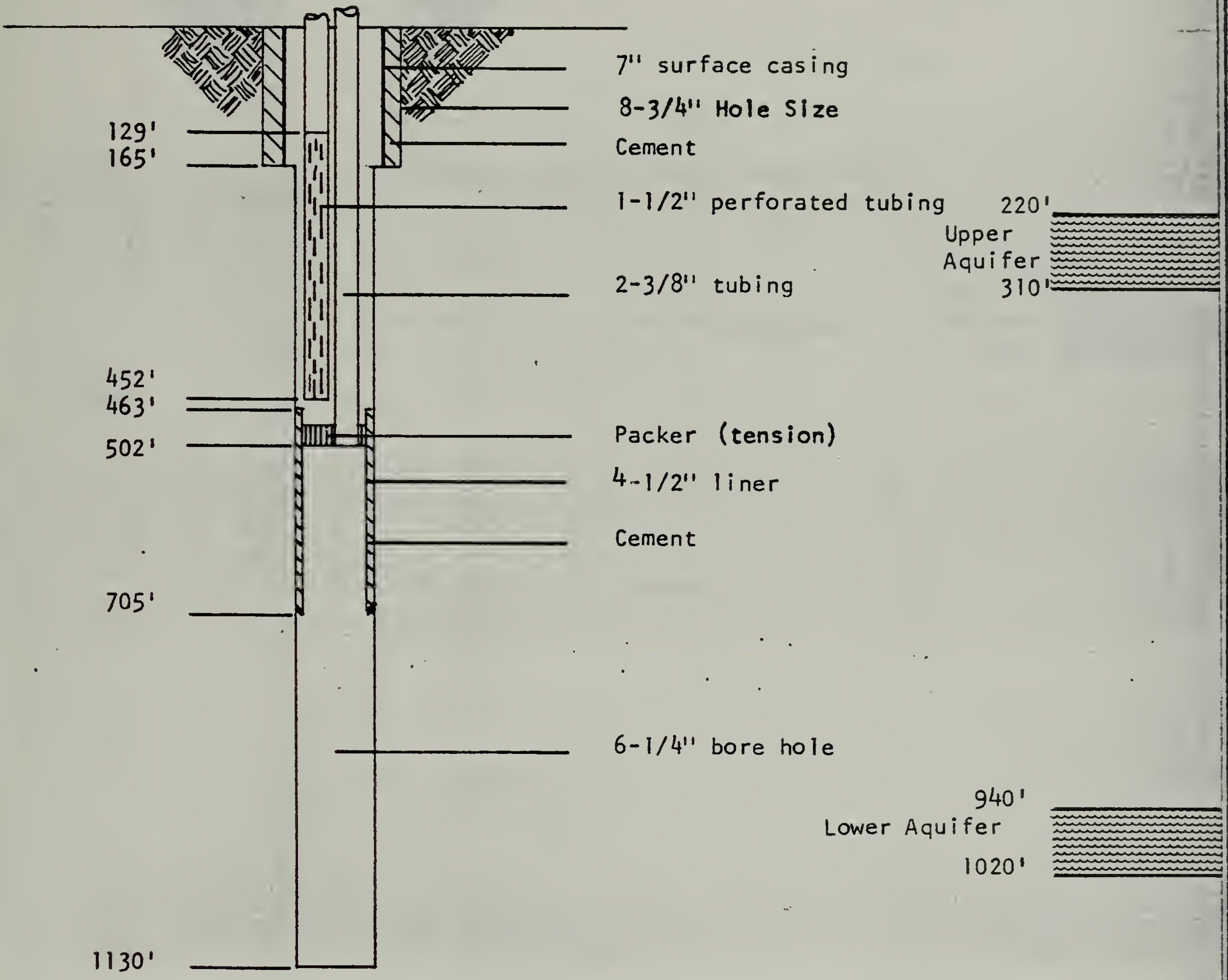
RIO BLANCO
OIL SHALE PROJECT

HOLE TO-1 DEPTH 1197
DECEMBER, 1974

WRIGHT WATER ENGINEERS [illegible]
[illegible]

VERITICAL SCALE 1" - 200'
HORIZONTAL SCALE 1"-1'0"

FIG. 7



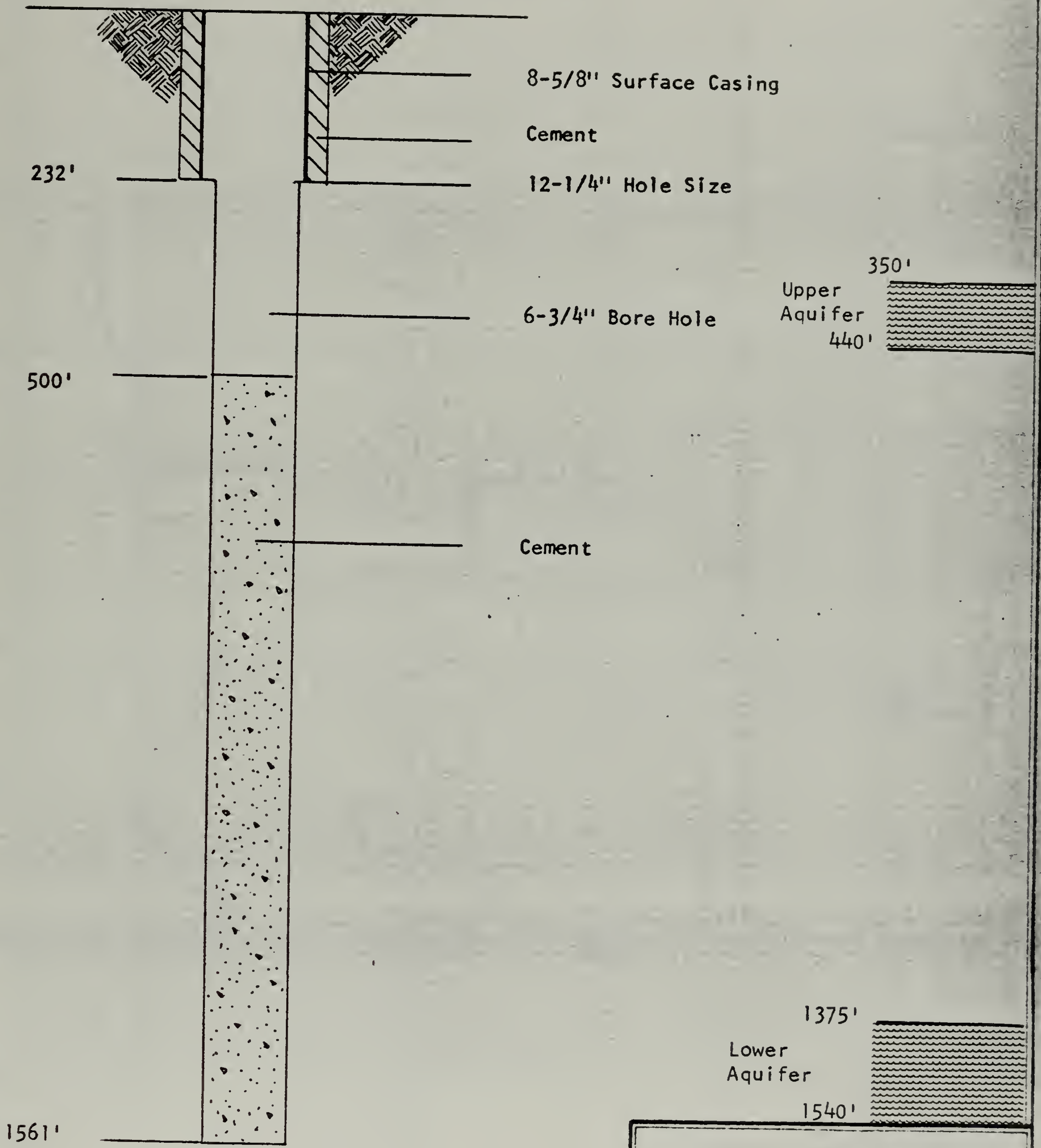
RIO BLANCO
OIL SHALE PROJECT

HOLE TO-2 DEPTH 1130
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC.
ENGINEERING CONSULTANTS
[illegible]
[illegible]

VERITICAL SCALE 1" - 200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7



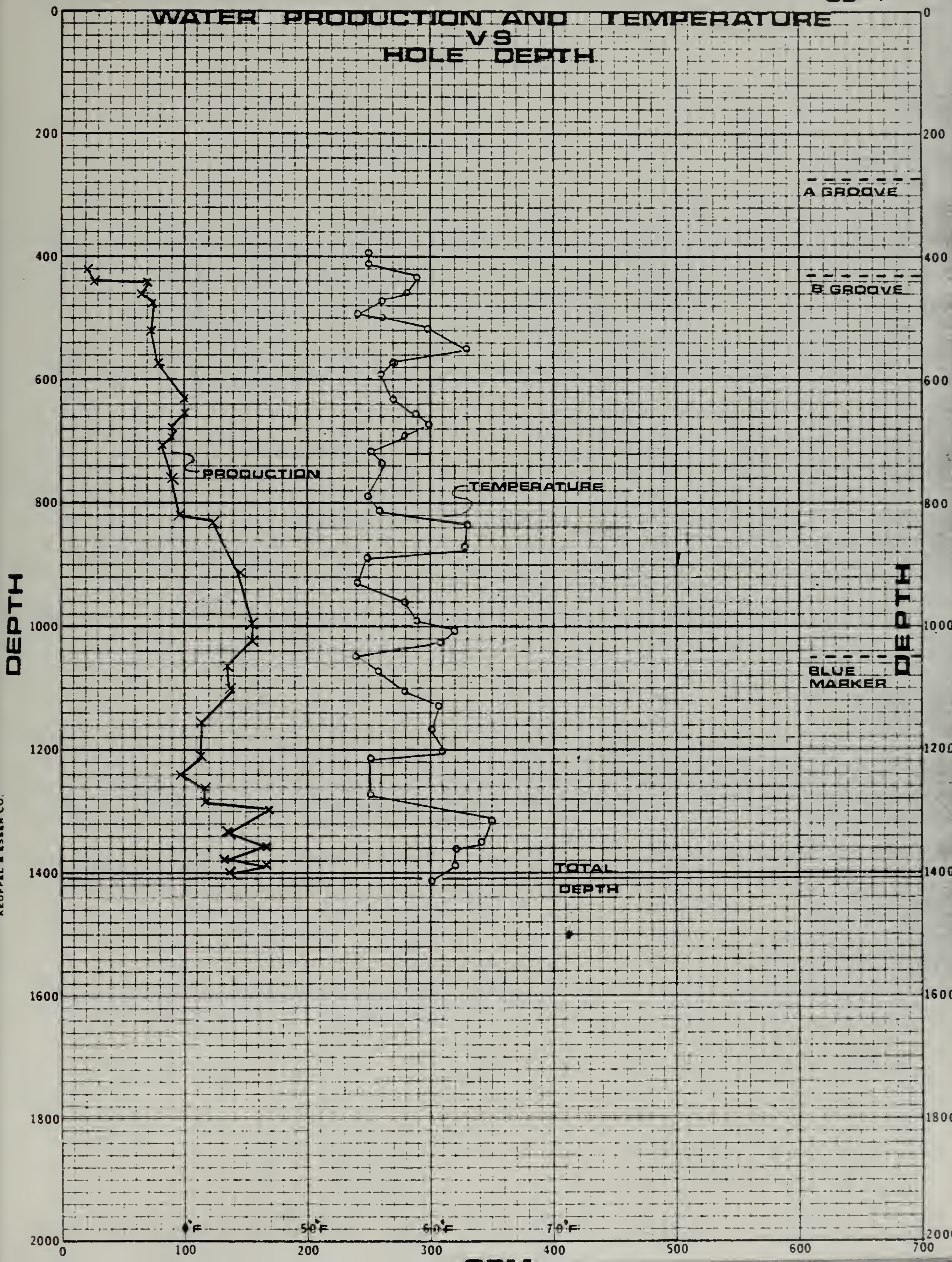
RIO BLANCO
OIL SHALE PROJECT

HOLE TO-3 DEPTH 1561
DECEMBER, 1974

WRIGHT WATER ENGINEERS, INC
ENGINEERING CONSULTANTS
[illegible]
DENVER [illegible]

ERITICAL SCALE 1"-200'
ORIZONTAL SCALE 1"-1' 0"

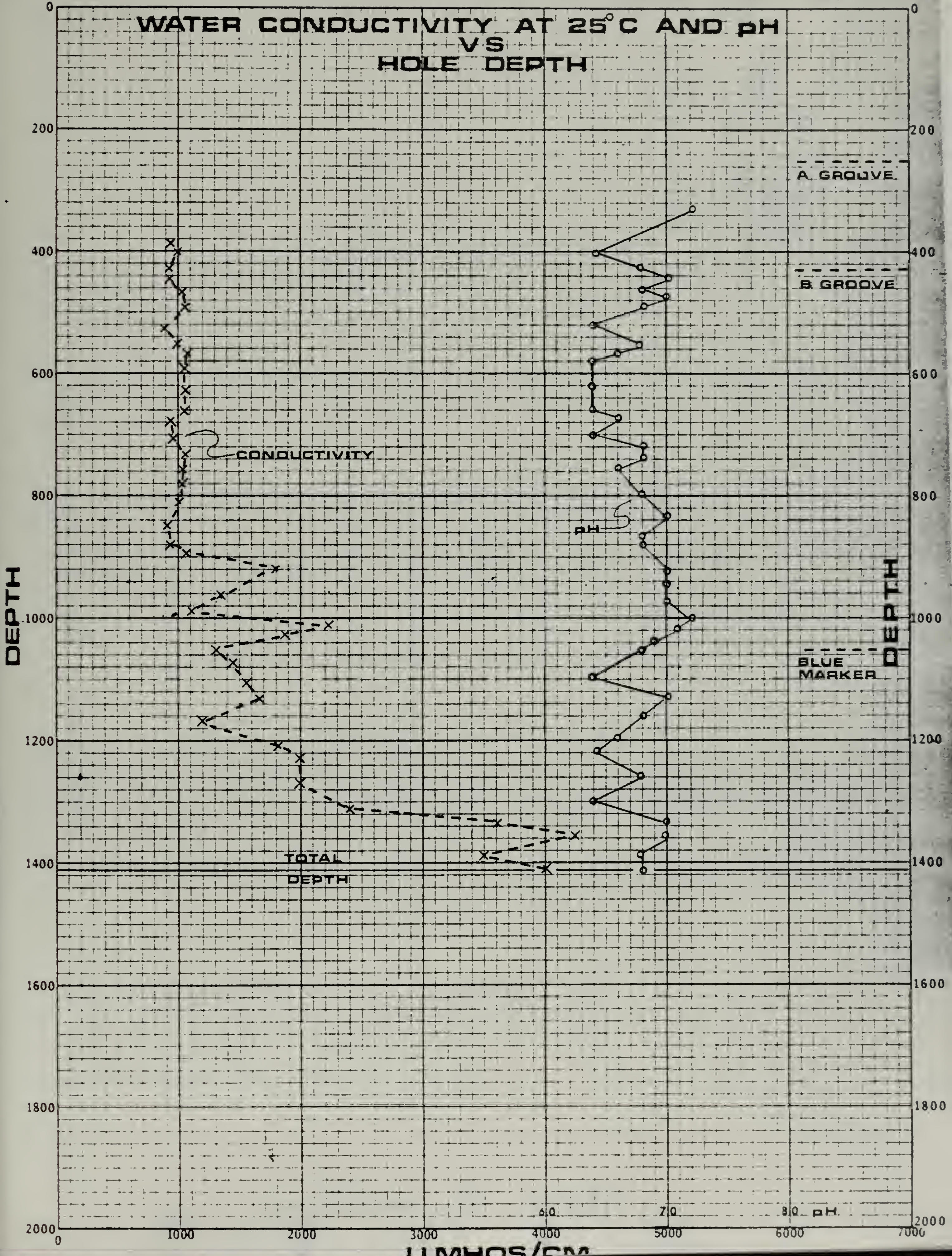
FIG. 7



WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH

KEUFFEL & ESSER CO.

GS-1


WATER CONDUCTIVITY AT 25°C AND pH VS HOLE DEPTH

KEUFFEL & ESSER CO.

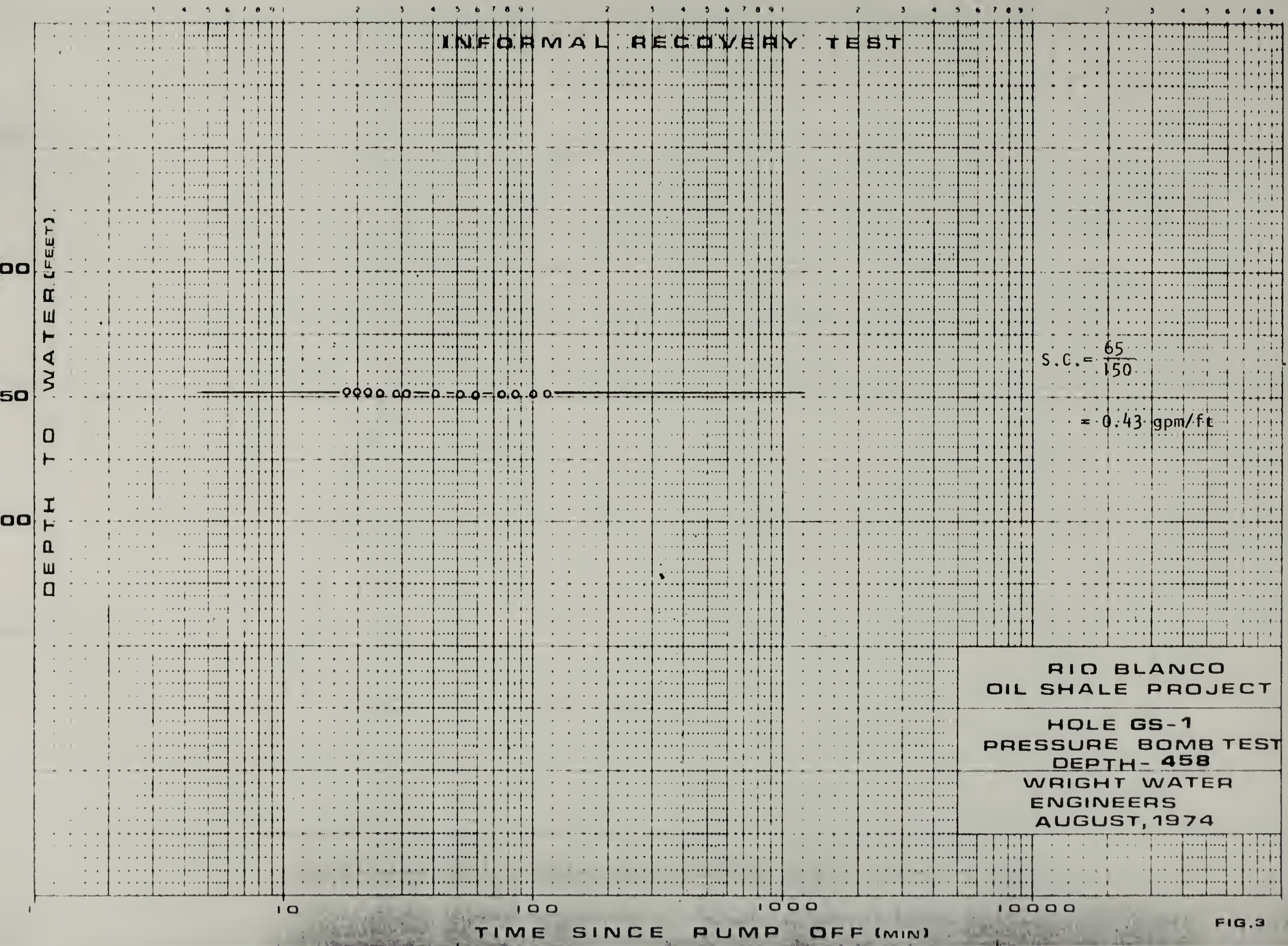

INFORMAL RECOVERY TEST
S.C. = 65/150
= 0.43 gpm/ft
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-1
PRESSURE BOMB TEST
DEPTH - 458
WRIGHT WATER
ENGINEERS
AUGUST, 1974
DEPTH TO WATER (FEET)
00
50
00
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)

FIG.3

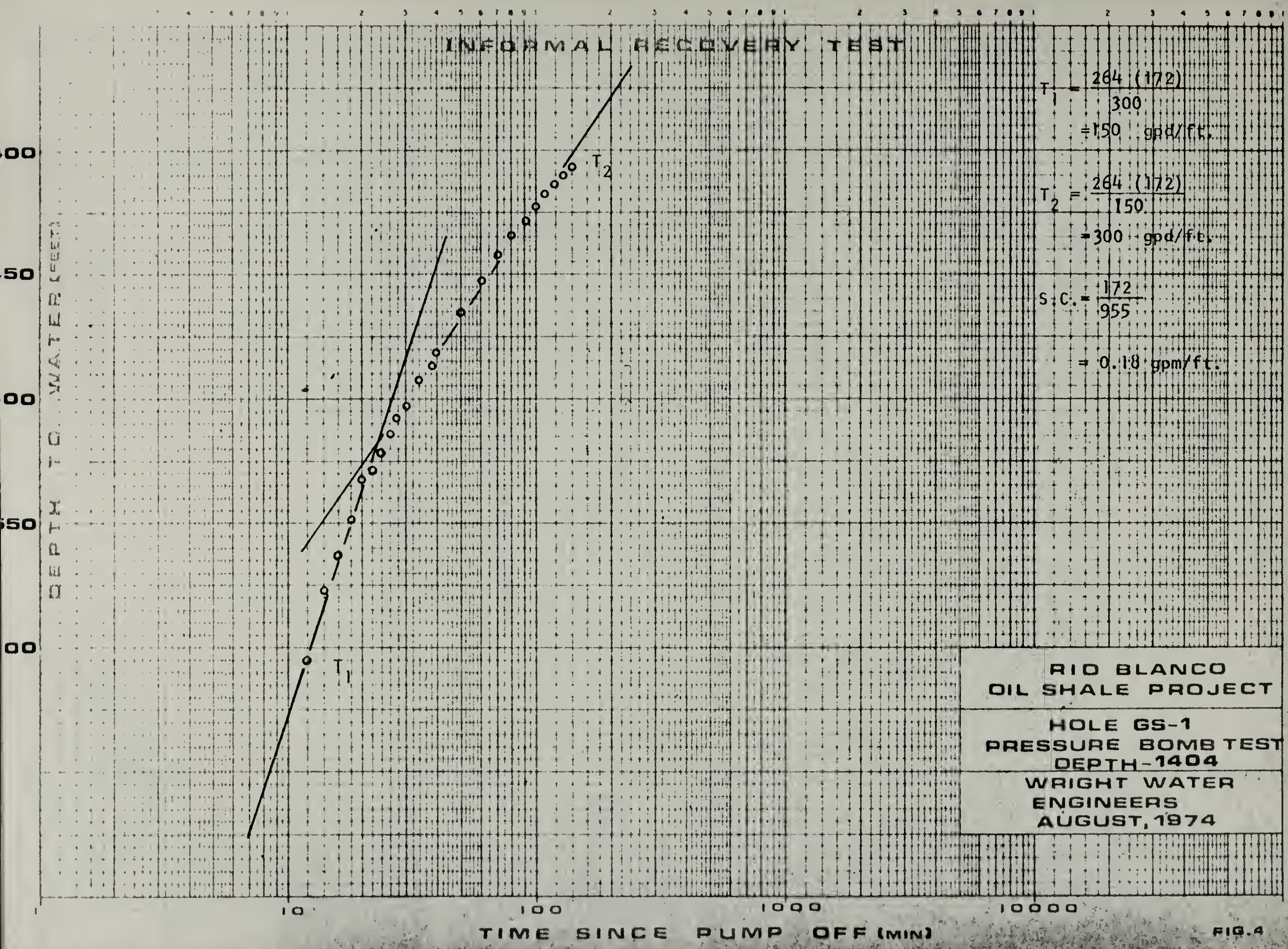

INFORMAL RECOVERY TEST
T1 = 264 (172) / 300
= 150 gpd/ft.
T2 = 264 (172) / 150
= 300 gpd/ft.
S.C. = 172 / 955
= 0.18 gpm/ft.
T2
T1
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-1
PRESSURE BOMB TEST
DEPTH-1404
WRIGHT WATER
ENGINEERS
AUGUST, 1974
DEPTH TO WATER (FEET)
00
50
00
50
00
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)

FIG.4

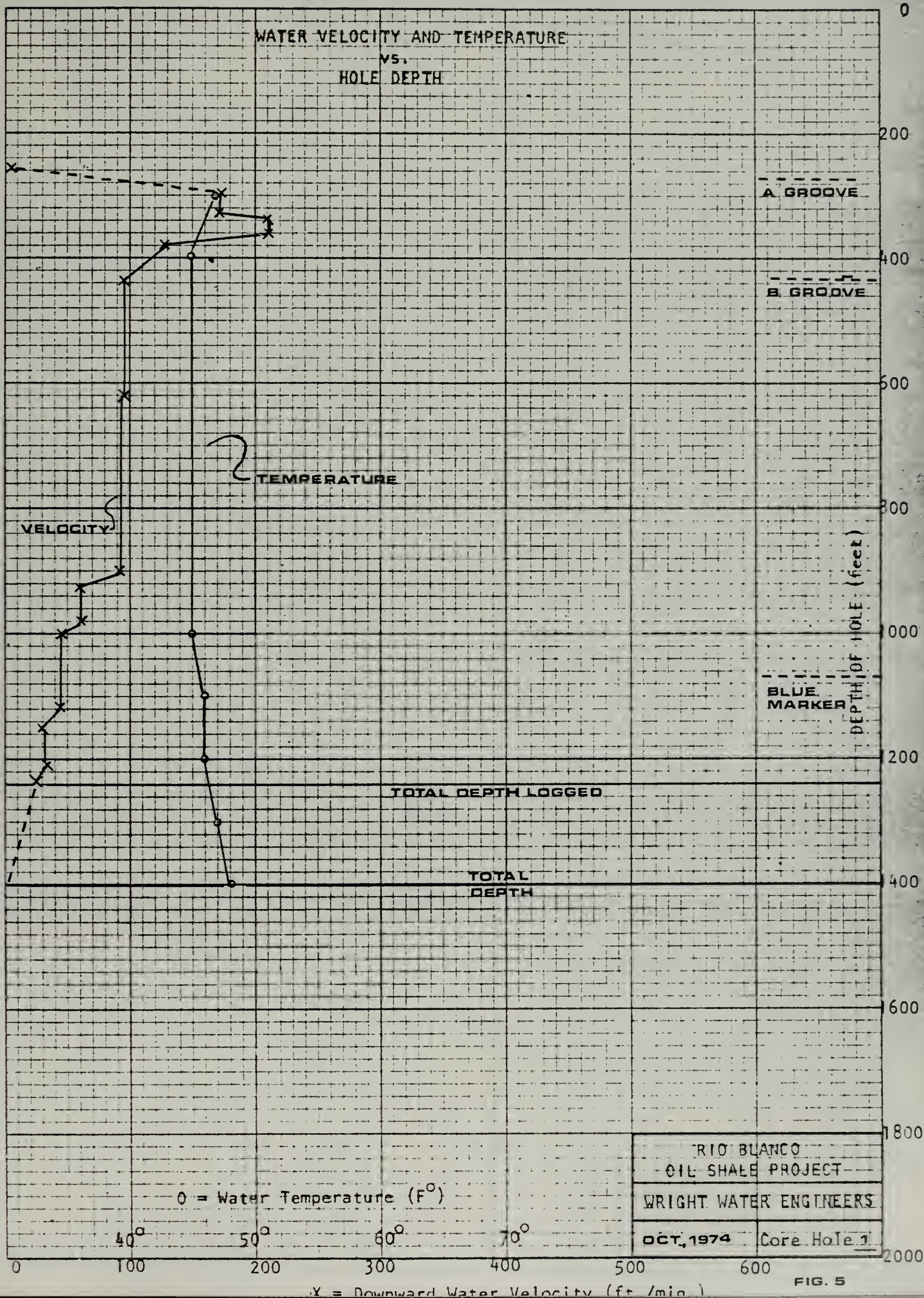
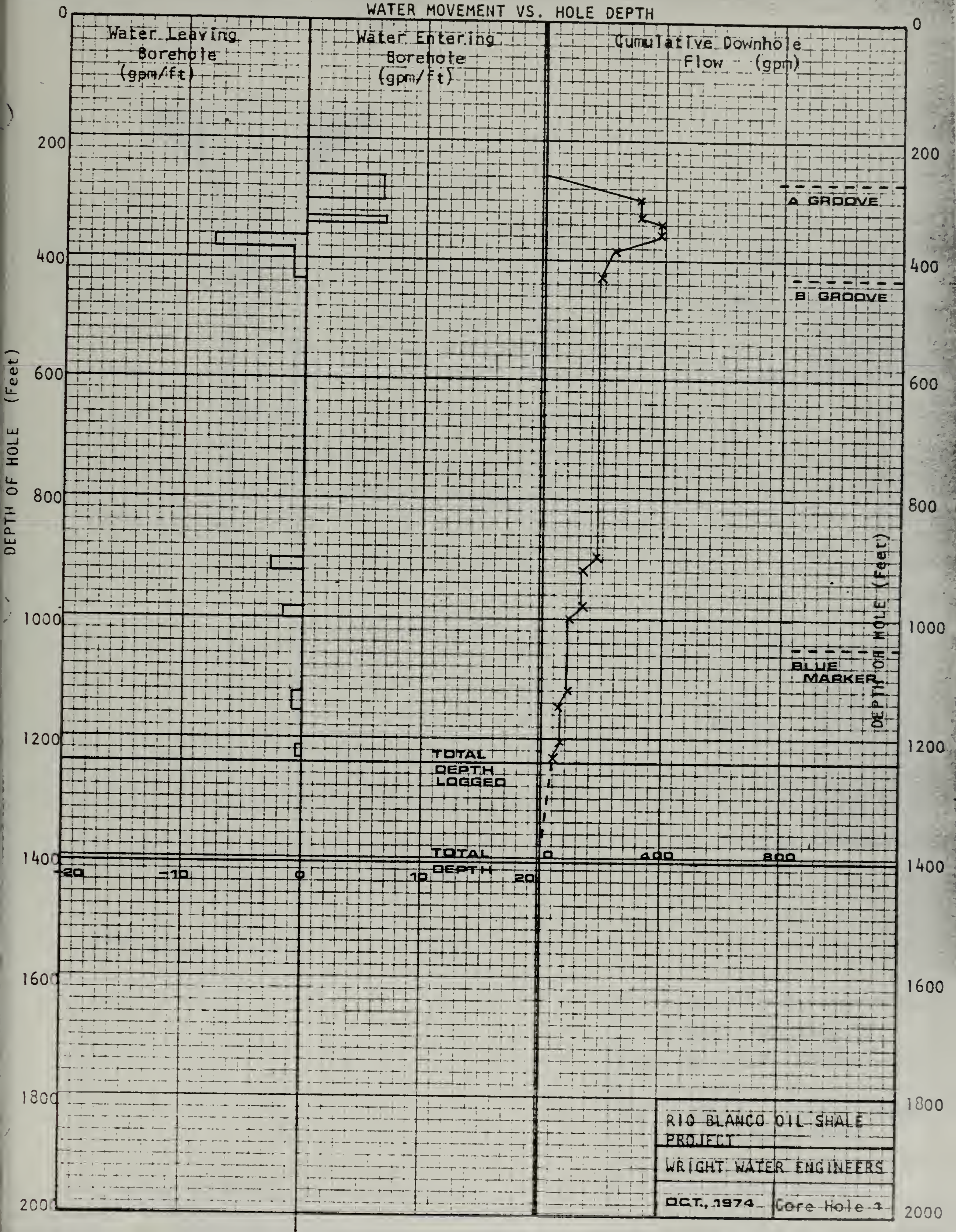
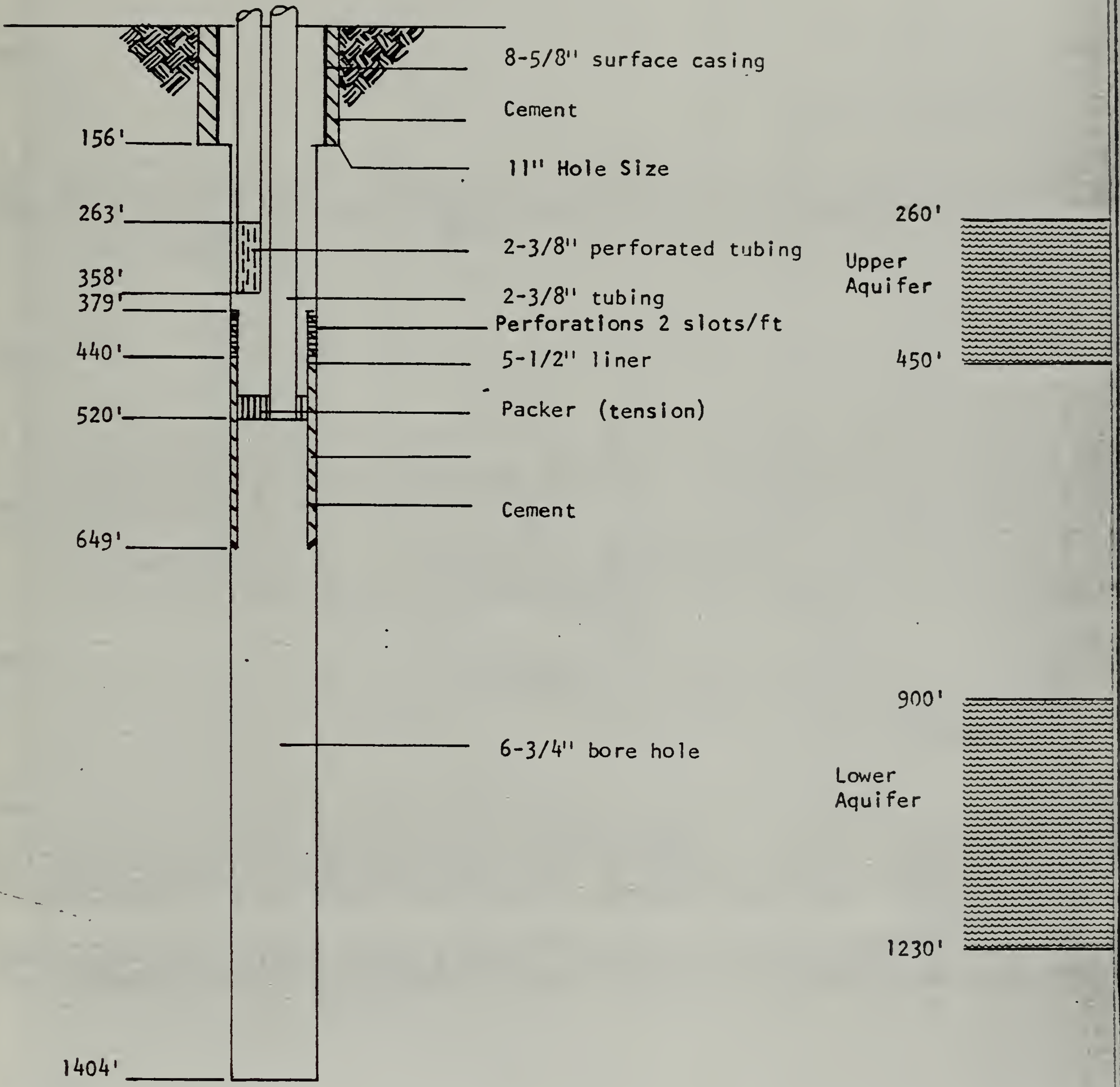


FIG. 5

KEUFFEL & ESSER CO.


WATER MOVEMENT VS. HOLE DEPTH
Water Leaving Borehole (gpm/ft)
Water Entering Borehole (gpm/ft)
Cumulative Downhole Flow (gpm)
DEPTH OF HOLE (Feet)
DEPTH OF HOLE (Feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
TOTAL DEPTH LOGGED
TOTAL DEPTH
-20
-10
0
10
20
0
400
800
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 1



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-1 DEPTH 1404
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
[illegible]
[illegible]

VERITICAL SCALE 1" - 200'
HORIZONTAL SCALE 1" - 1'-0"

FIG. 7

GS-2-3

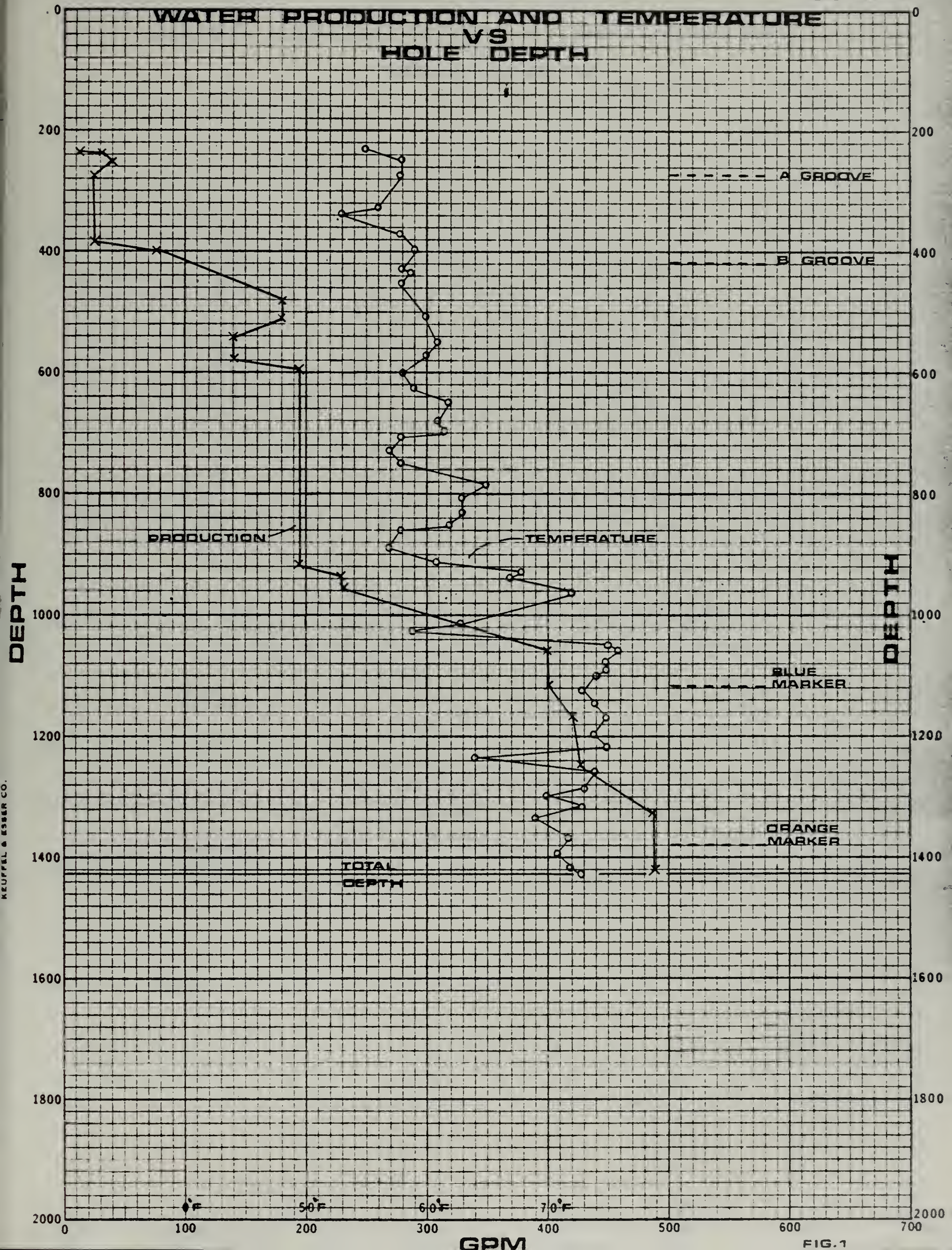
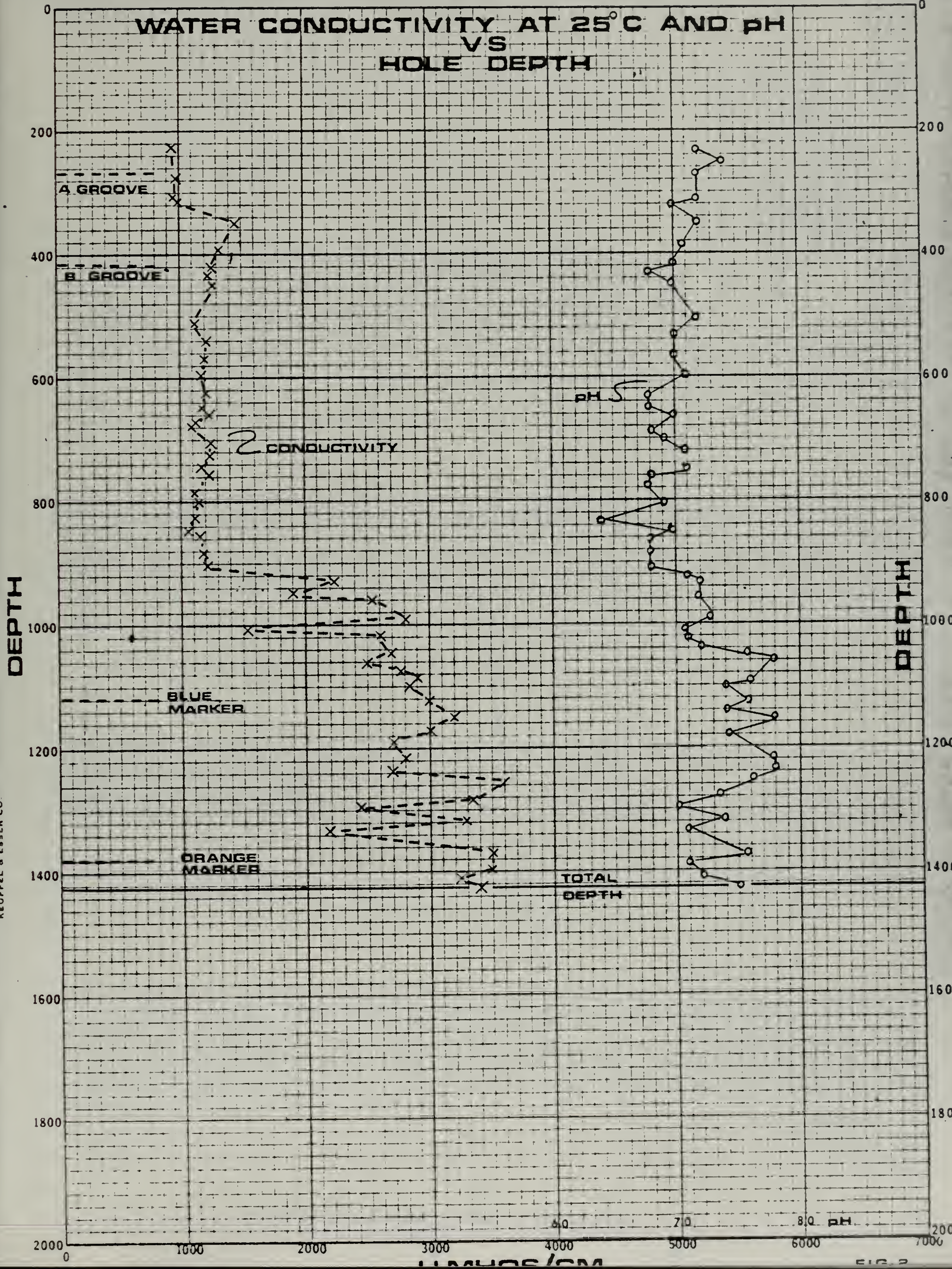

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
PRODUCTION
TEMPERATURE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
40°F
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM
KEUFFEL & ESSER CO.

FIG.1



WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH

FIG. 2

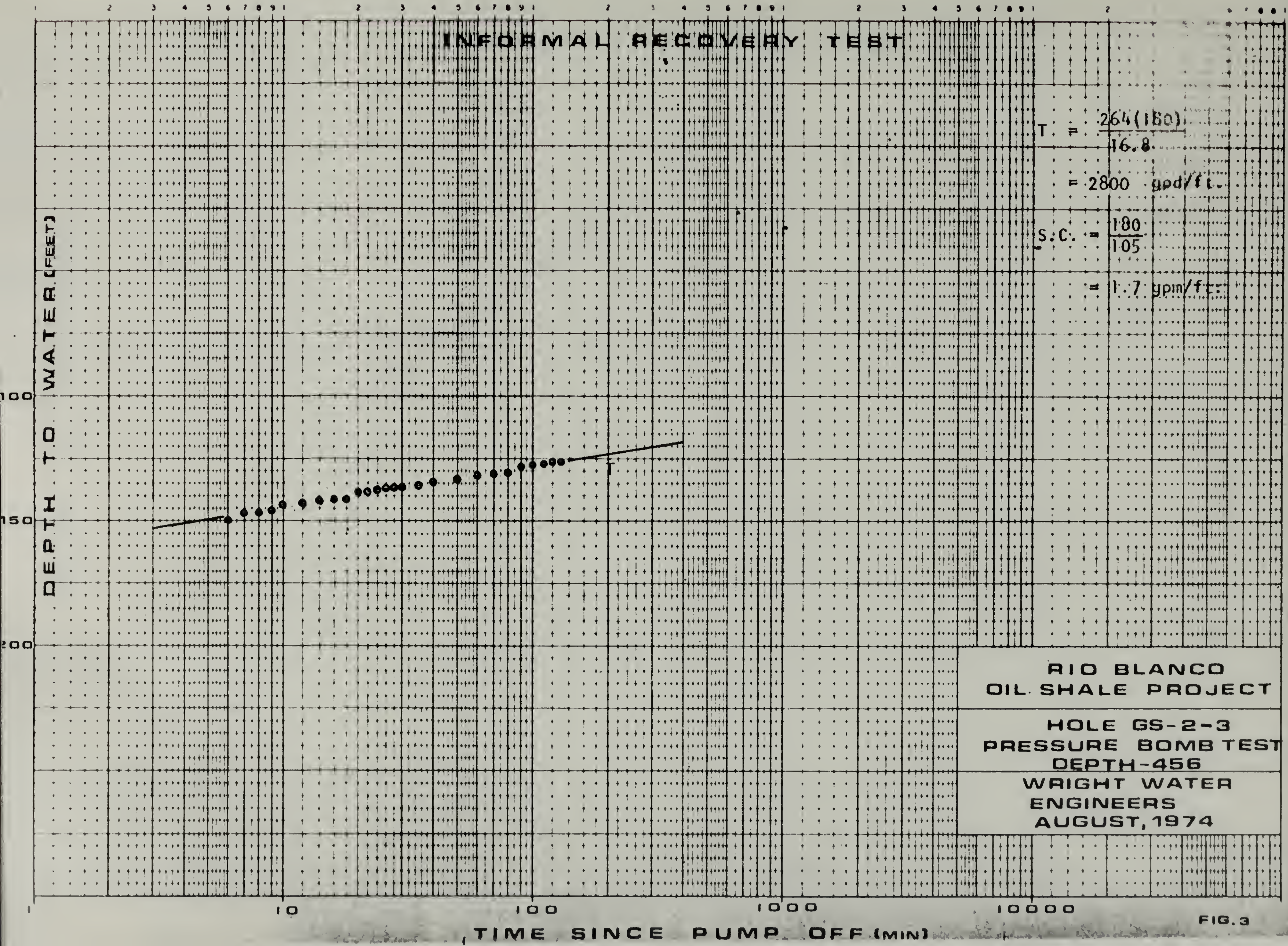

INFORMAL RECOVERY TEST
T = 264(180) / 16.8
= 2800 gpd/ft.
S.C. = 180 / 1.05
= 1.7 gpm/ft.
DEPTH TO WATER (FEET)
100
150
200
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-2-3
PRESSURE BOMB TEST
DEPTH-456
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3

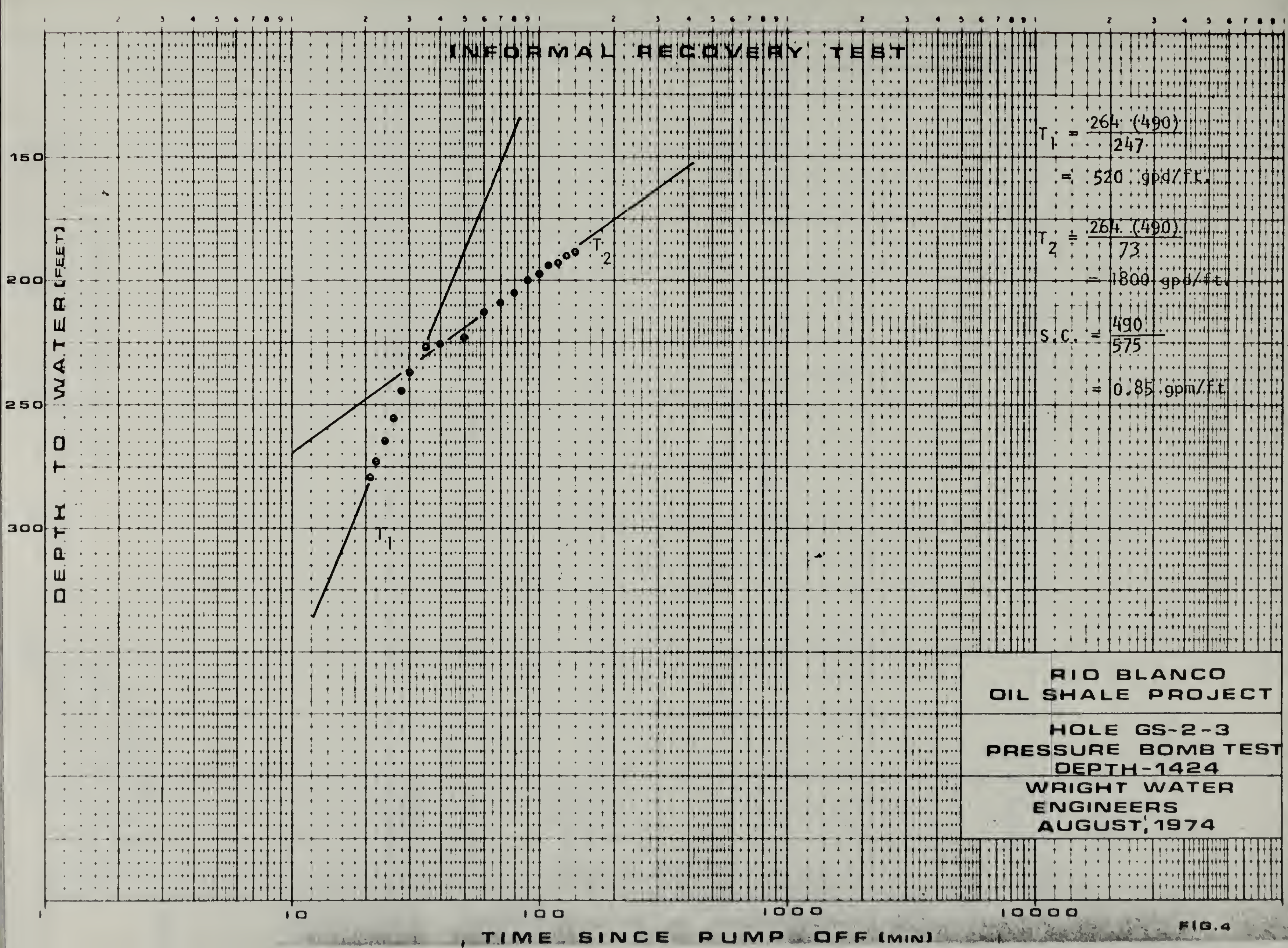

INFORMAL RECOVERY TEST
T1 = 264 (490) / 247
= 520 gpd/ft.
T2 = 264 (490) / 73
= 1800 gpd/ft.
S.C. = 490 / 575
= 0.85 gpm/ft.
T2
T1
150
200
250
300
DEPTH TO WATER (FEET)
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-2-3
PRESSURE BOMB TEST
DEPTH-1424
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.4

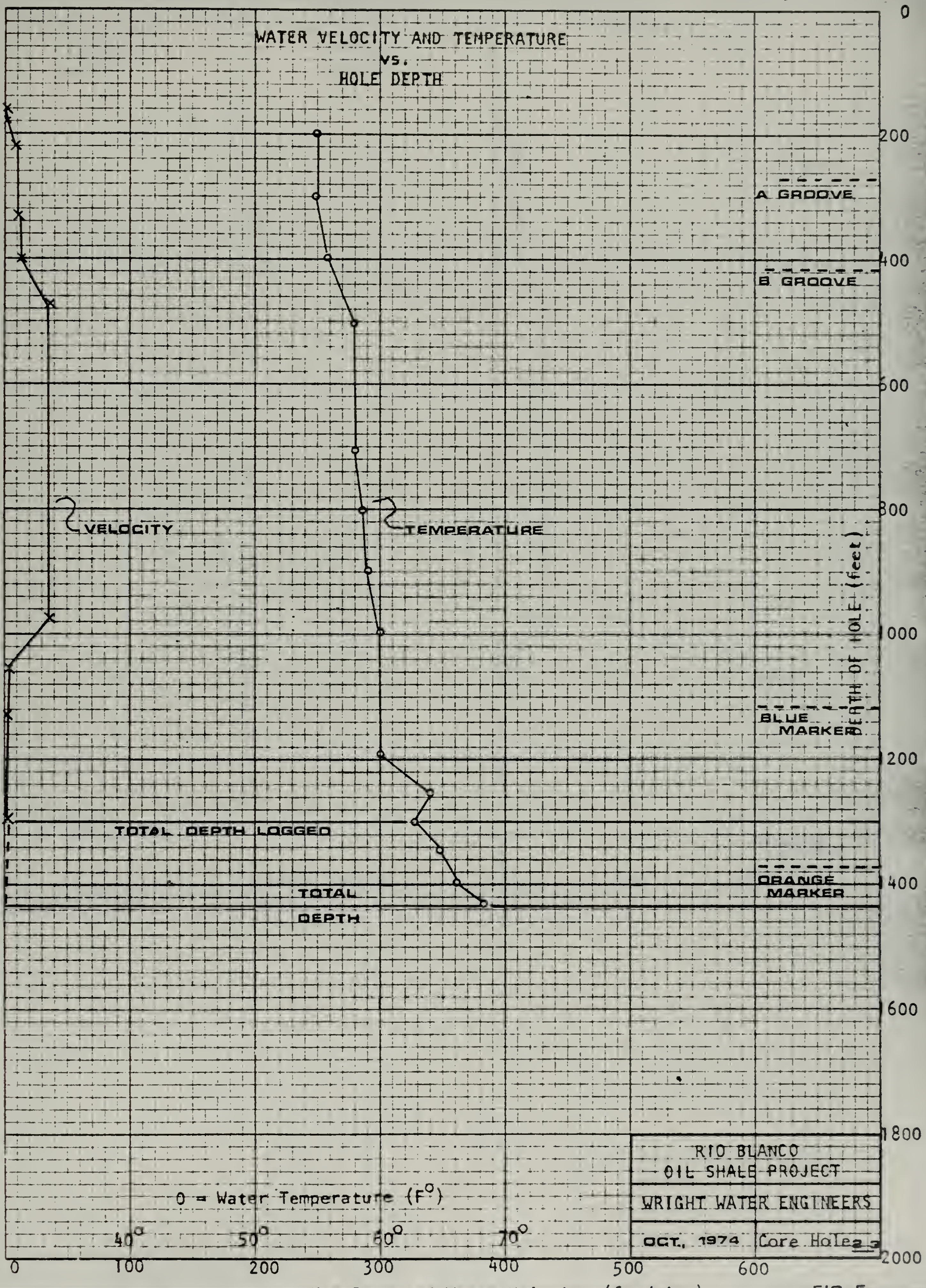

WATER VELOCITY AND TEMPERATURE
VS.
HOLE DEPTH
VELOCITY
TEMPERATURE
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH LOGGED
TOTAL DEPTH
DEPTH OF HOLE (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0 = Water Temperature (F°)
40°
50°
60°
70°
0
100
200
300
400
500
600
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 2

FIG 5

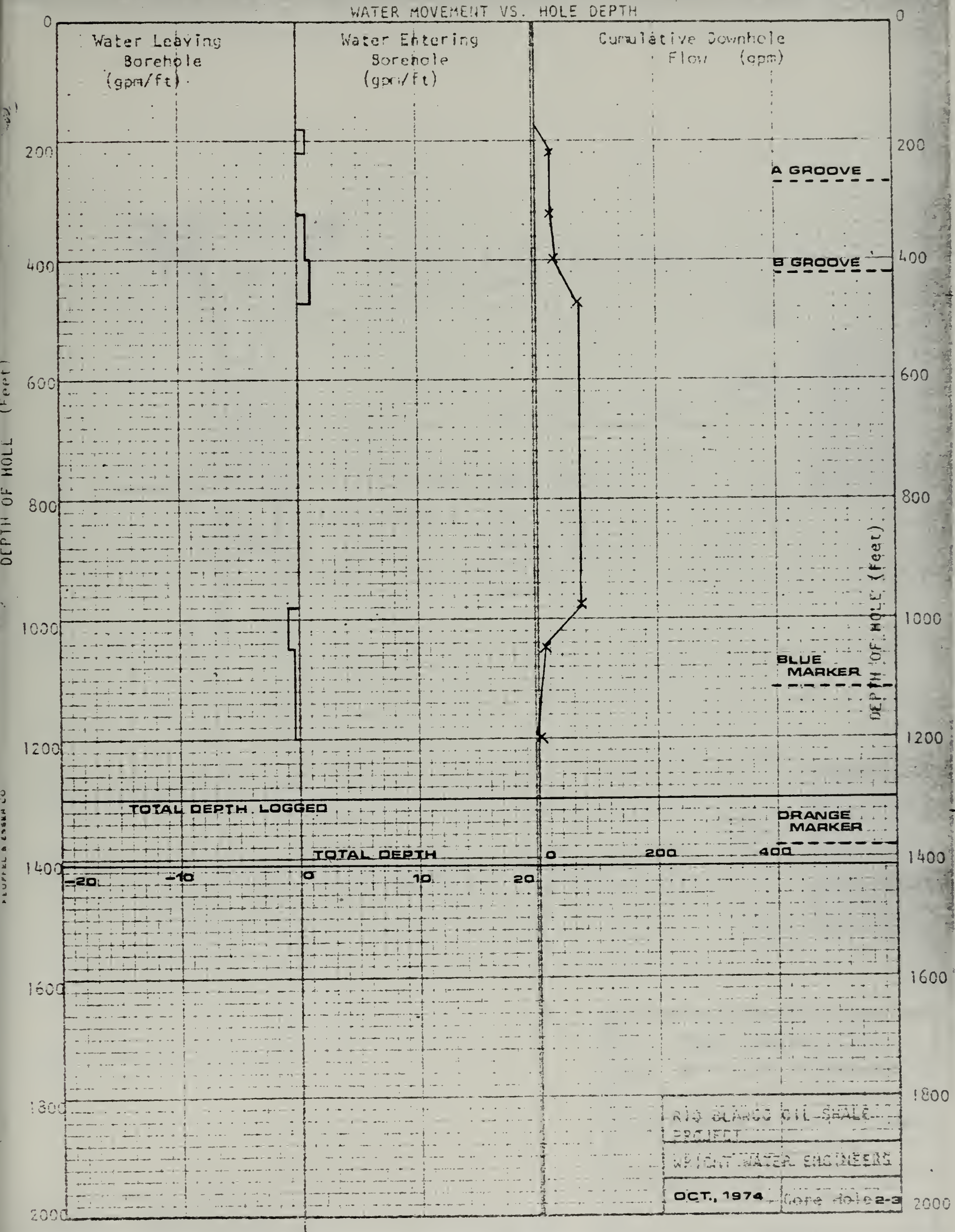
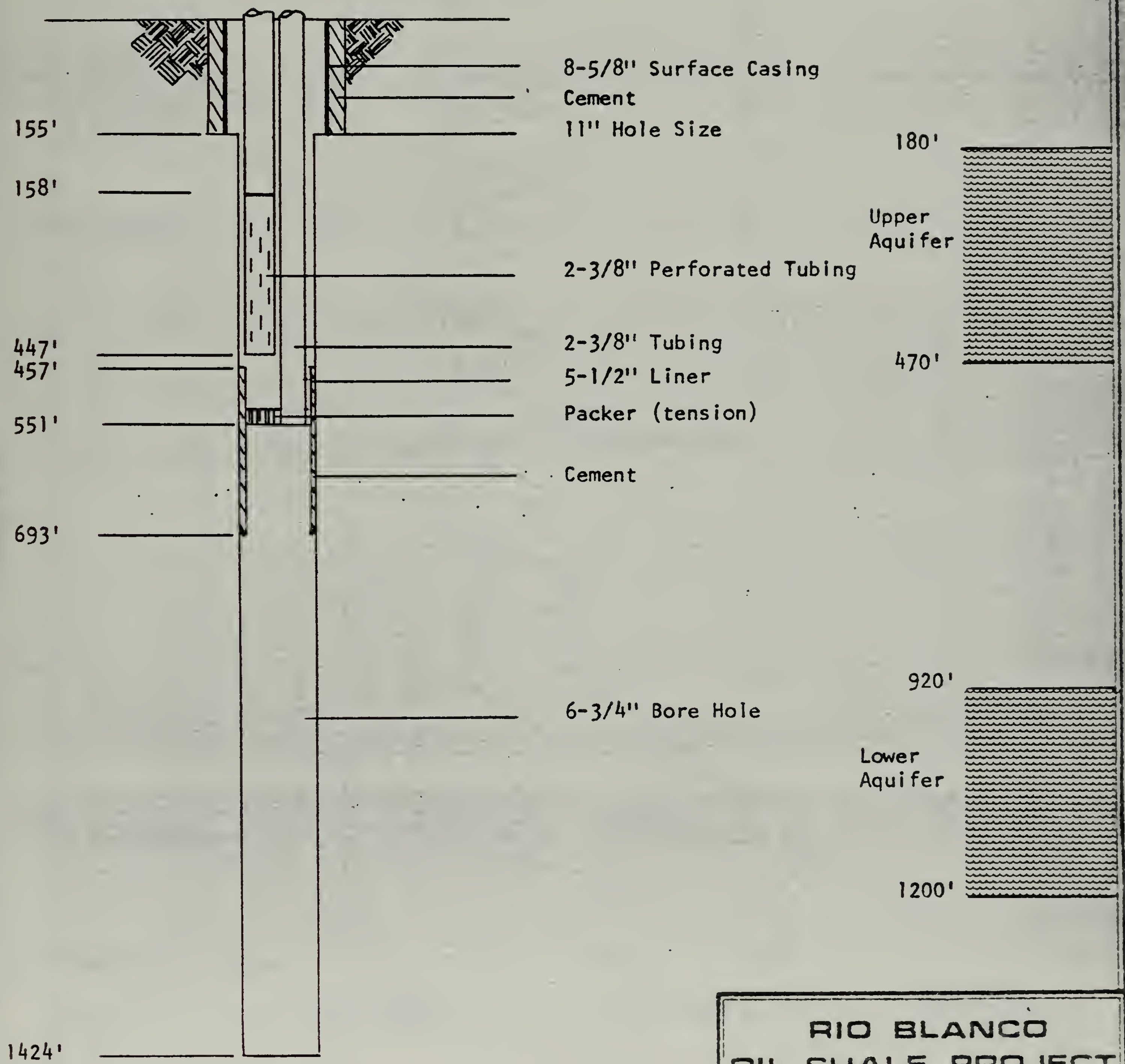

WATER MOVEMENT VS. HOLE DEPTH
Water Leaving Borehole (gpm/ft)
Water Entering Borehole (gpm/ft)
Cumulative Downhole Flow (gpm)
DEPTH OF HOLE (Feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH LOGGED
TOTAL DEPTH
-20
-10
0
10
20
0
200
400
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 2-3

FIG. 6



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-2-3 DEPTH 1424
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

GS-4-5

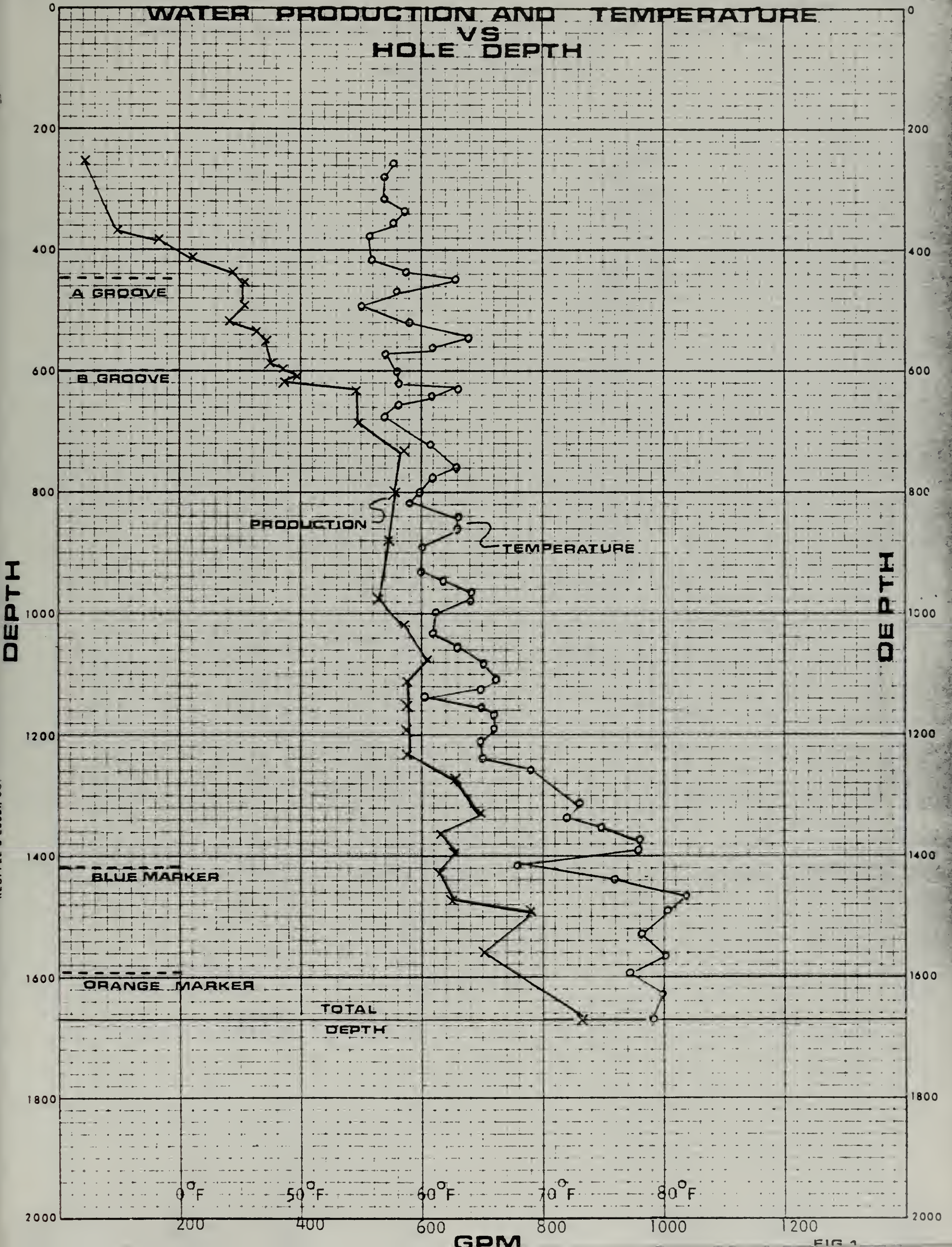
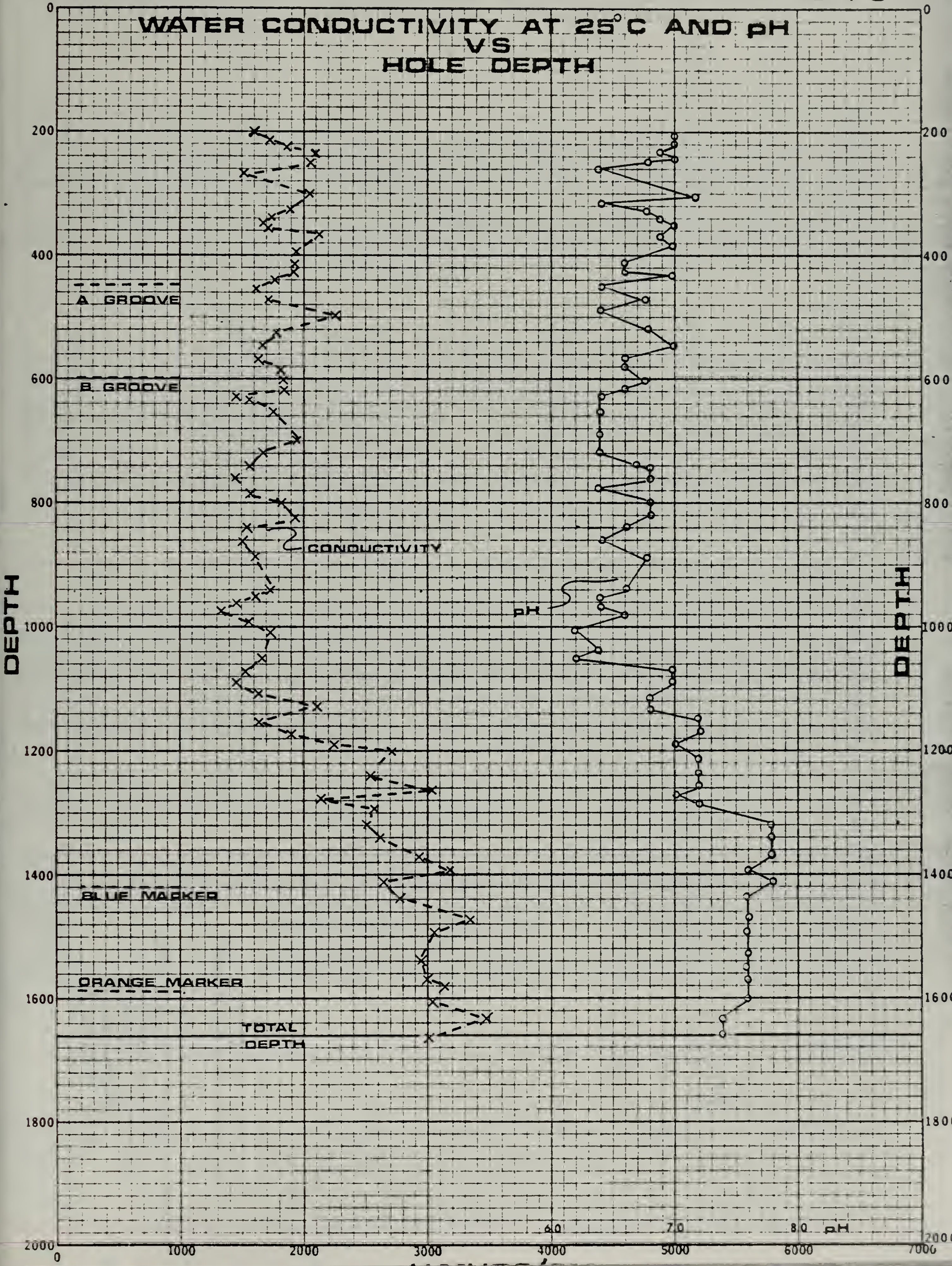
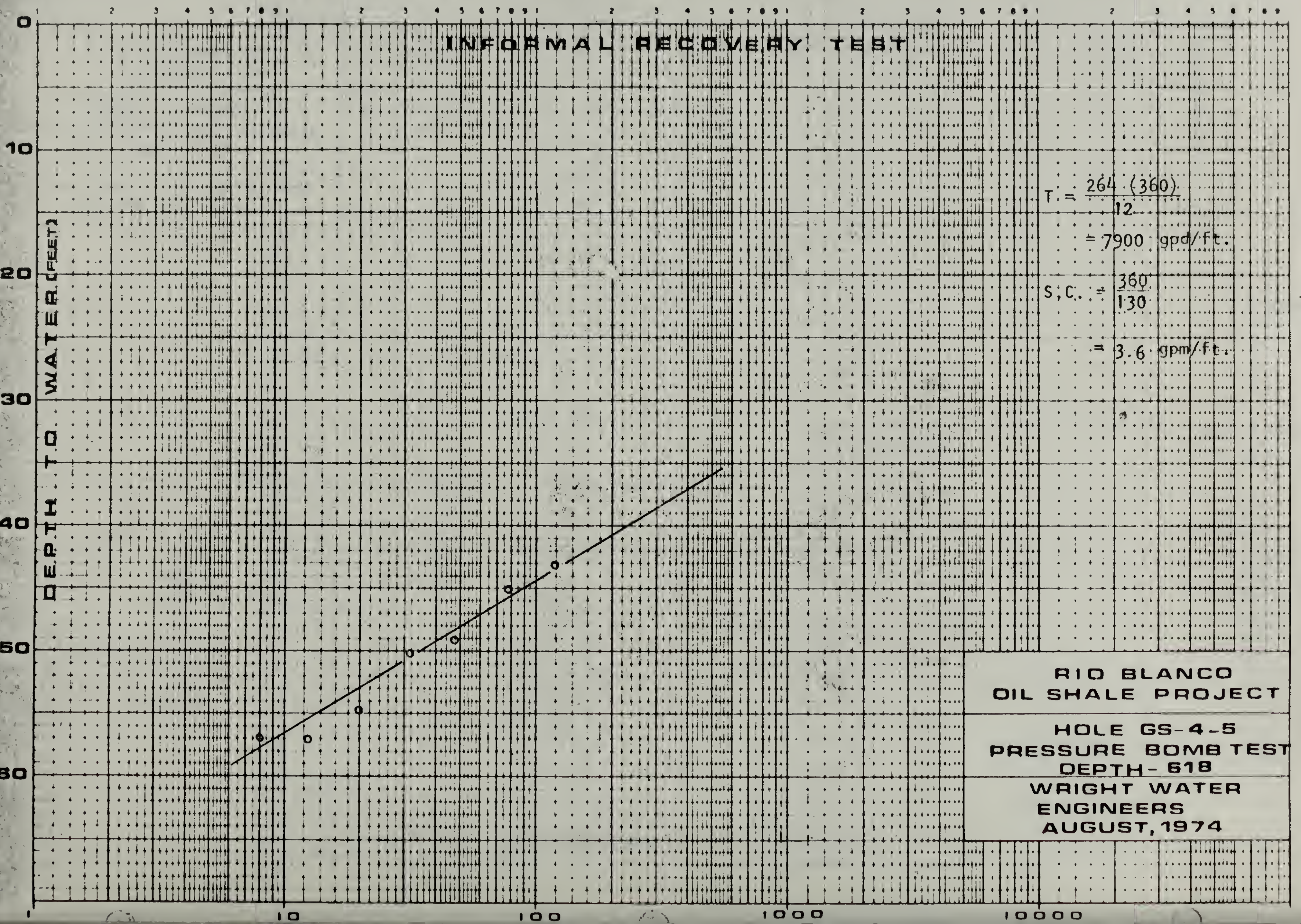

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
PRODUCTION
TEMPERATURE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
0°F
50°F
60°F
70°F
80°F
200
400
600
800
1000
1200
GPM
KEUFFEL & ESSER CO.

FIG 1

GS-4-5


WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
CONDUCTIVITY
pH
0
1000
2000
3000
4000
5000
6000
7000
6.0
7.0
8.0 pH


INFORMAL RECOVERY TEST
DEPTH TO WATER (FEET)
0
10
20
30
40
50
60
1
10
100
1000
10000
T = 264 (360) / 12
≐ 7900 gpd/ft.
S.C. ≐ 360 / 130
≐ 3.6 gpm/ft.
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-4-5
PRESSURE BOMB TEST
DEPTH - 618
WRIGHT WATER
ENGINEERS
AUGUST, 1974
WWE GW-1

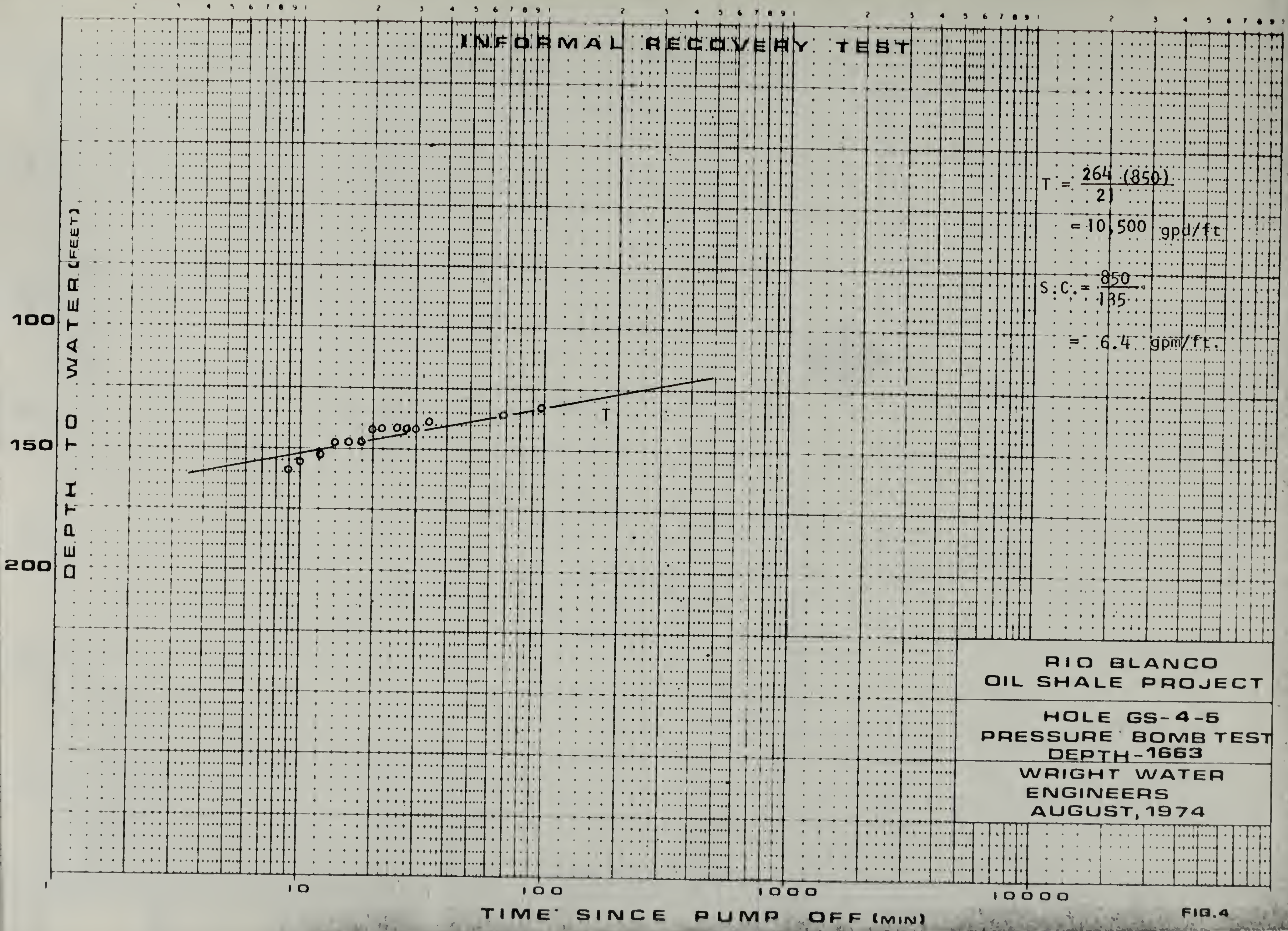

INFORMAL RECOVERY TEST
T = 264 (850) / 21
= 10,500 gpd/ft
S.C. = 850 / 135
= 6.4 gpm/ft.
T
DEPTH TO WATER (FEET)
100
150
200
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-4-5
PRESSURE BOMB TEST
DEPTH-1663
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.4

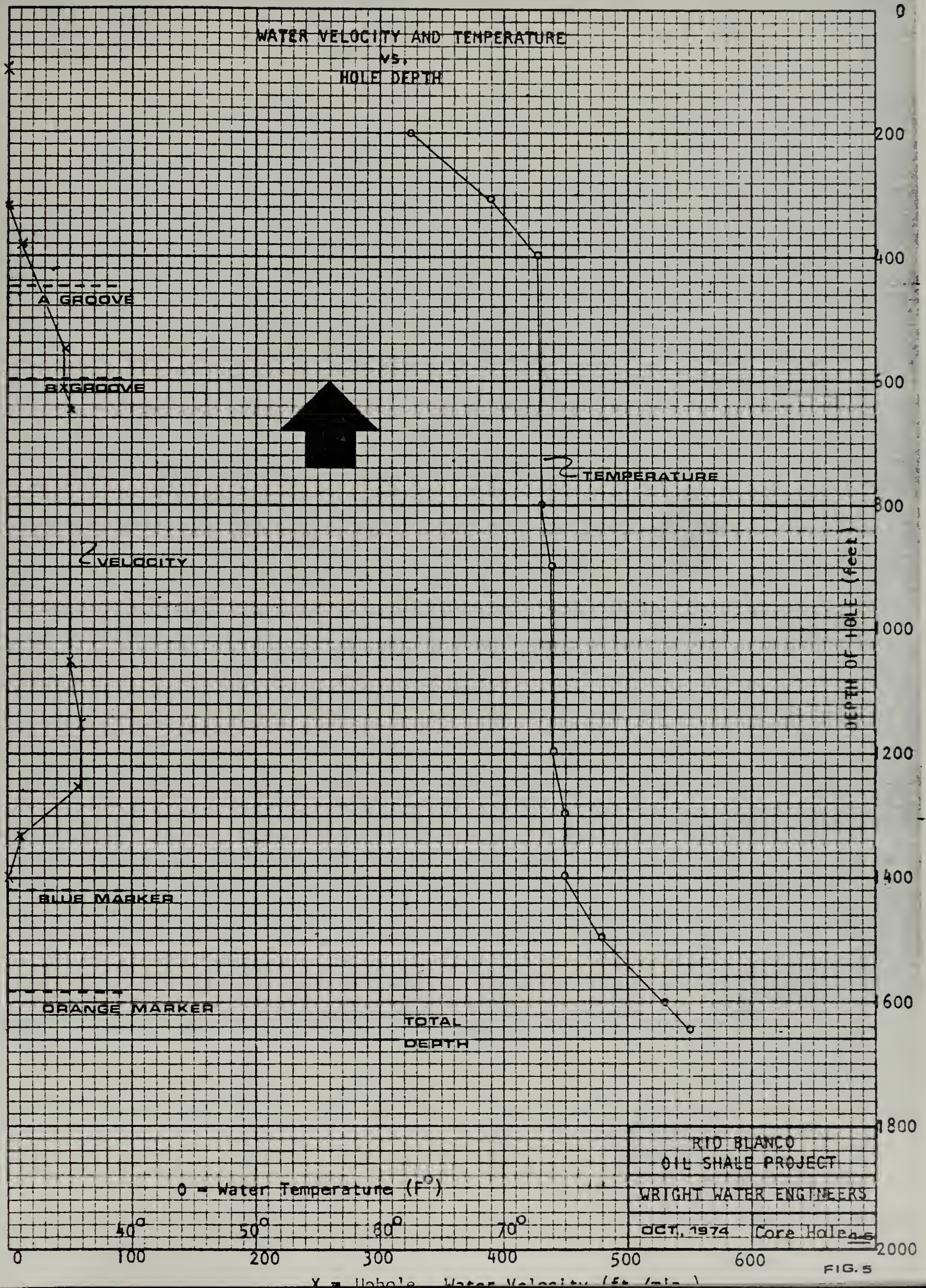


FIG. 5

7 X 10 INCHES
KEUFFEL & ESSER CO.
MADE IN U.S.A.

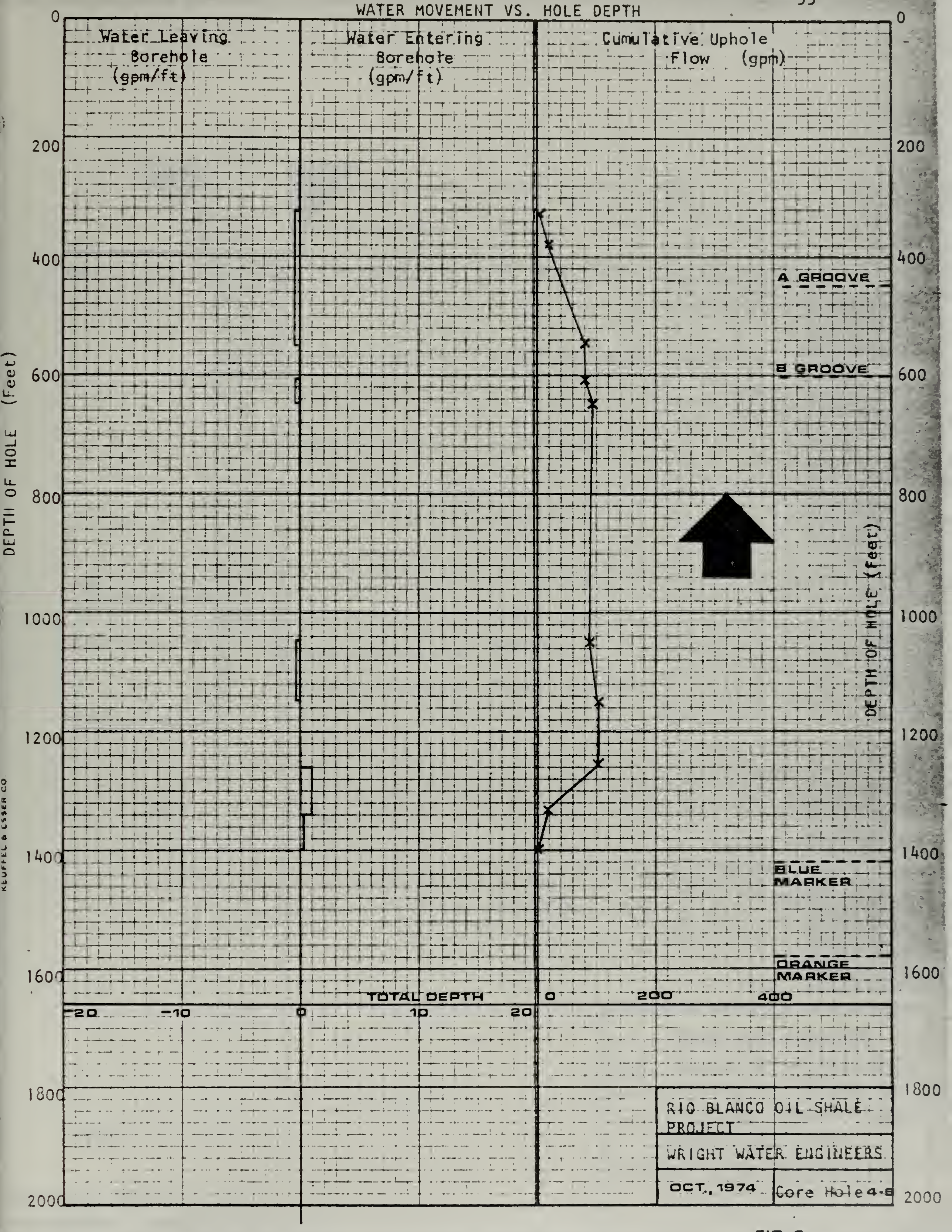
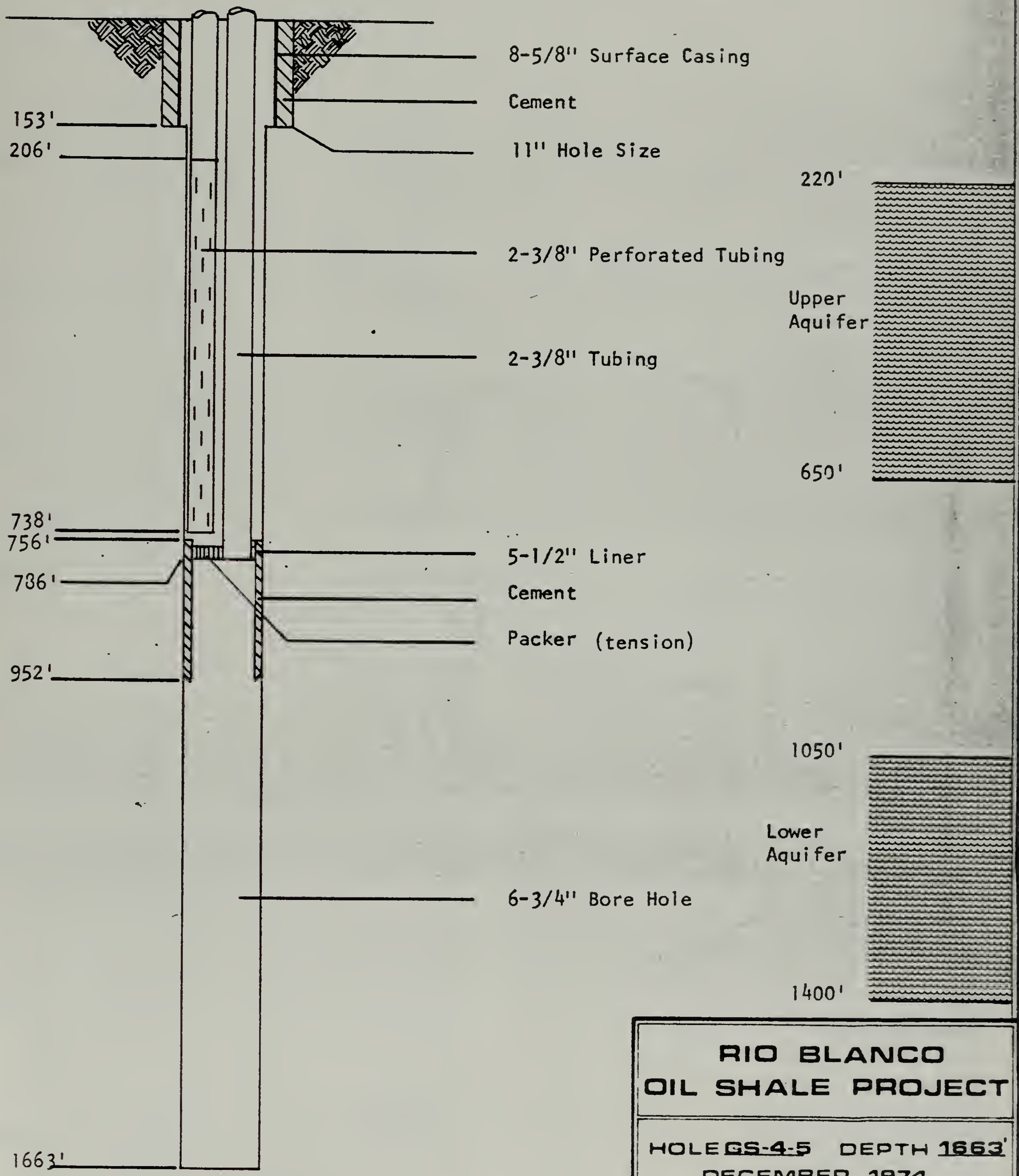

WATER MOVEMENT VS. HOLE DEPTH
Water Leaving Borehole (gpm/ft)
Water Entering Borehole (gpm/ft)
Cumulative Uphole Flow (gpm)
DEPTH OF HOLE (Feet)
DEPTH OF HOLE (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
-20
-10
0
10
20
0
200
400
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 4-B
KEUFFEL & ESSER CO.

FIG. 6



VERTICAL SCALE 1" - 200'

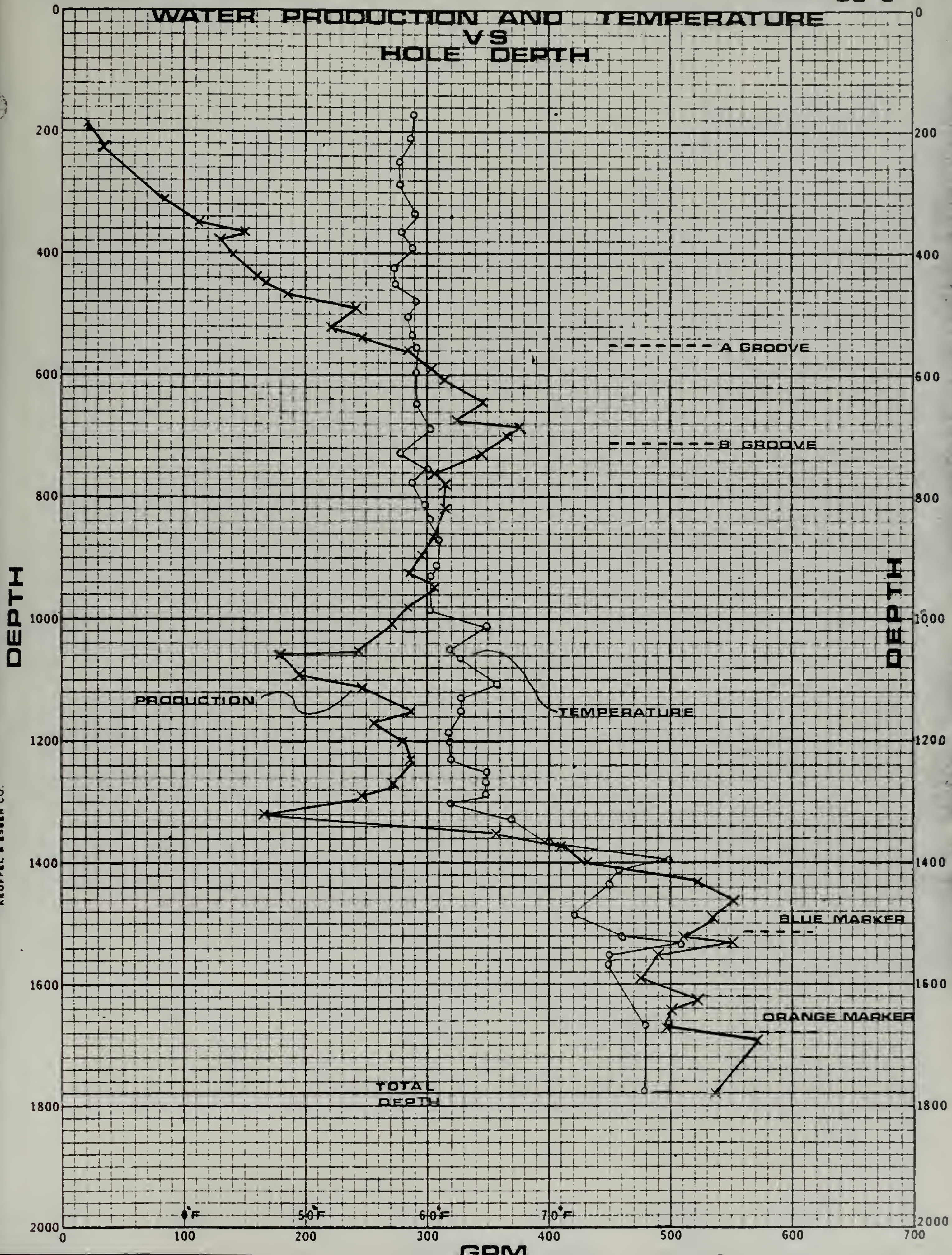
HORIZONTAL SCALE 1" - 1'-0"

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-4-5 DEPTH 1663'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

GS-6



WATER PRODUCTION AND TEMPERATURE VS HOLE DEPTH

KEUFFEL & ESSER CO.

GS-6

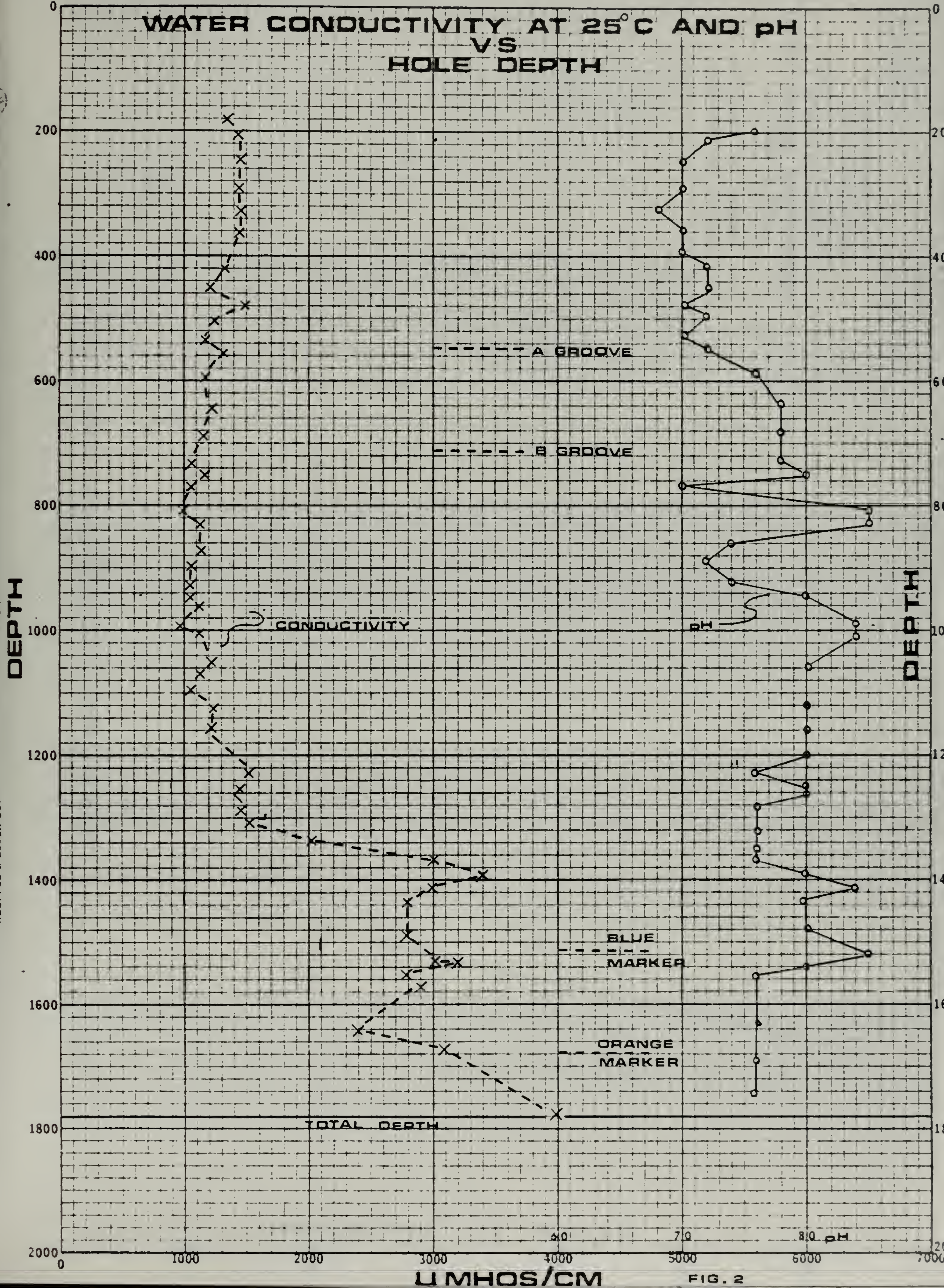

WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
CONDUCTIVITY
pH
BLUE
MARKER
ORANGE
MARKER
TOTAL DEPTH
0
1000
2000
3000
4000
5000
6000
7000
6.0
7.0
8.0 pH
UMHOS/CM
KEUFFEL & ESSER CO.

FIG. 2

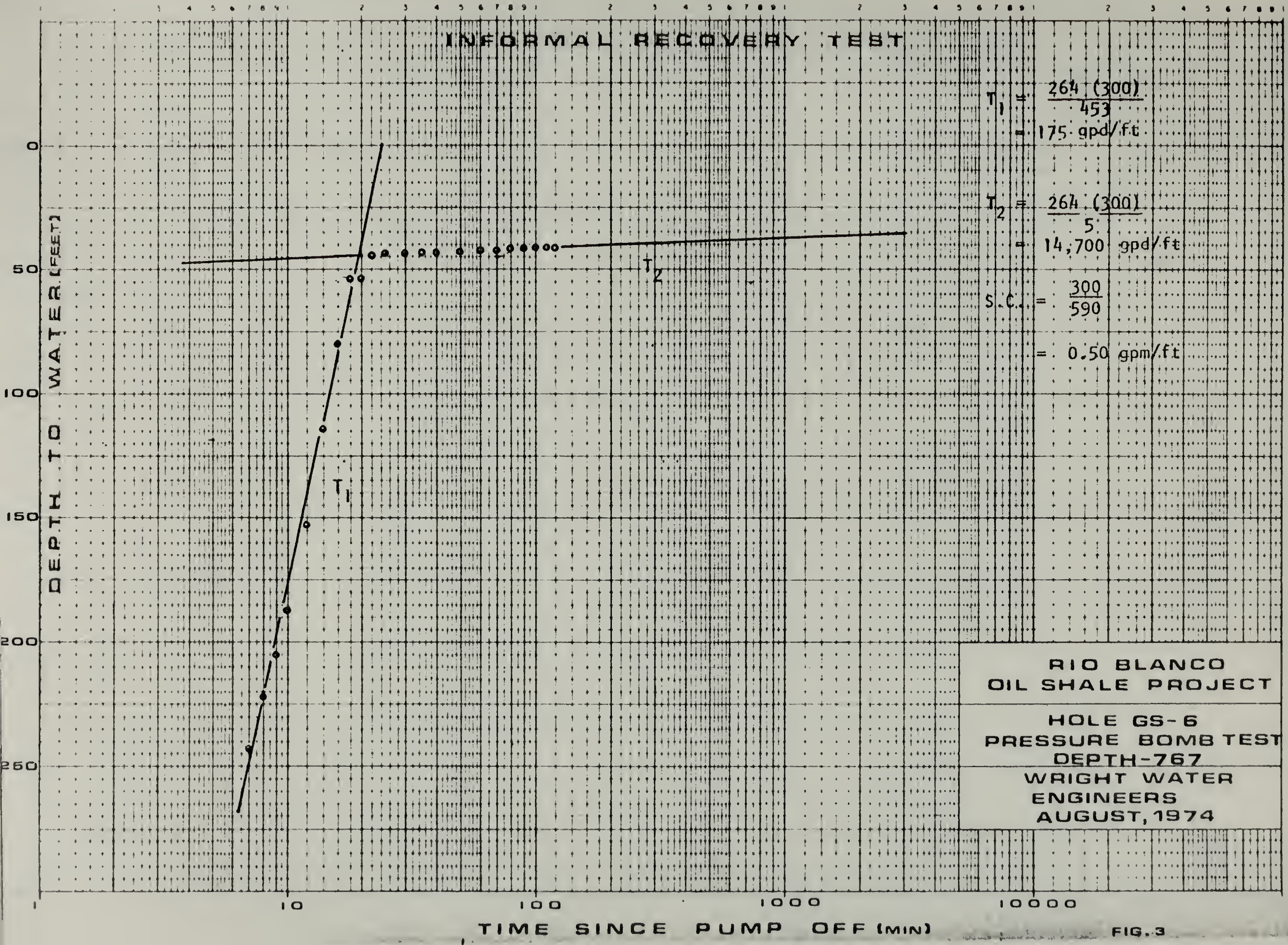

INFORMAL RECOVERY TEST
$T_1 = \frac{264\ (300)}{453}$
$= 175$ gpd/ft
$T_2 = \frac{264\ (300)}{5}$
$= 14,700$ gpd/ft
S.C. $= \frac{300}{590}$
$= 0.50$ gpm/ft
T_1
T_2
DEPTH TO WATER (FEET)
0
50
100
150
200
250
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-6
PRESSURE BOMB TEST
DEPTH-767
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3

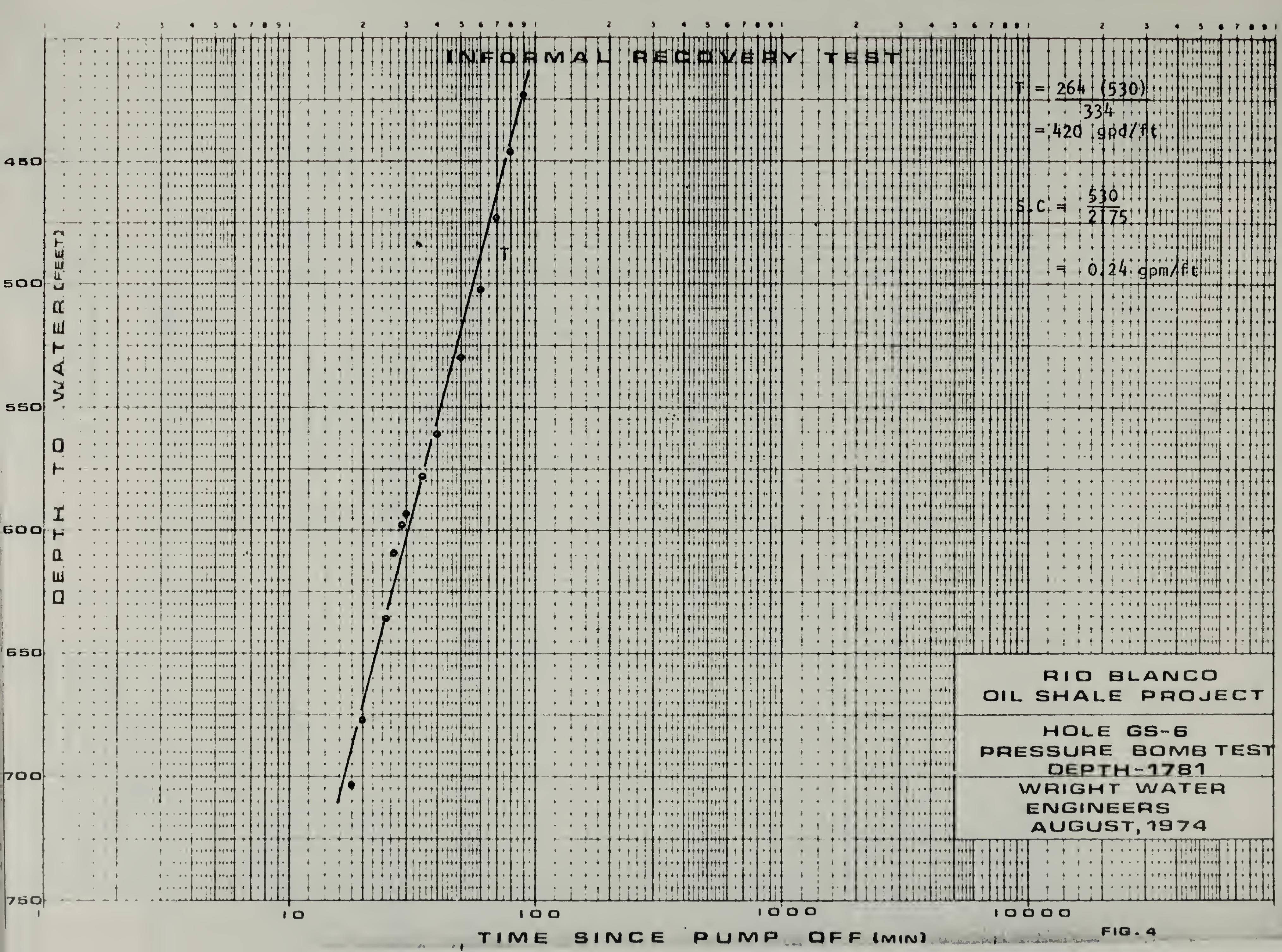
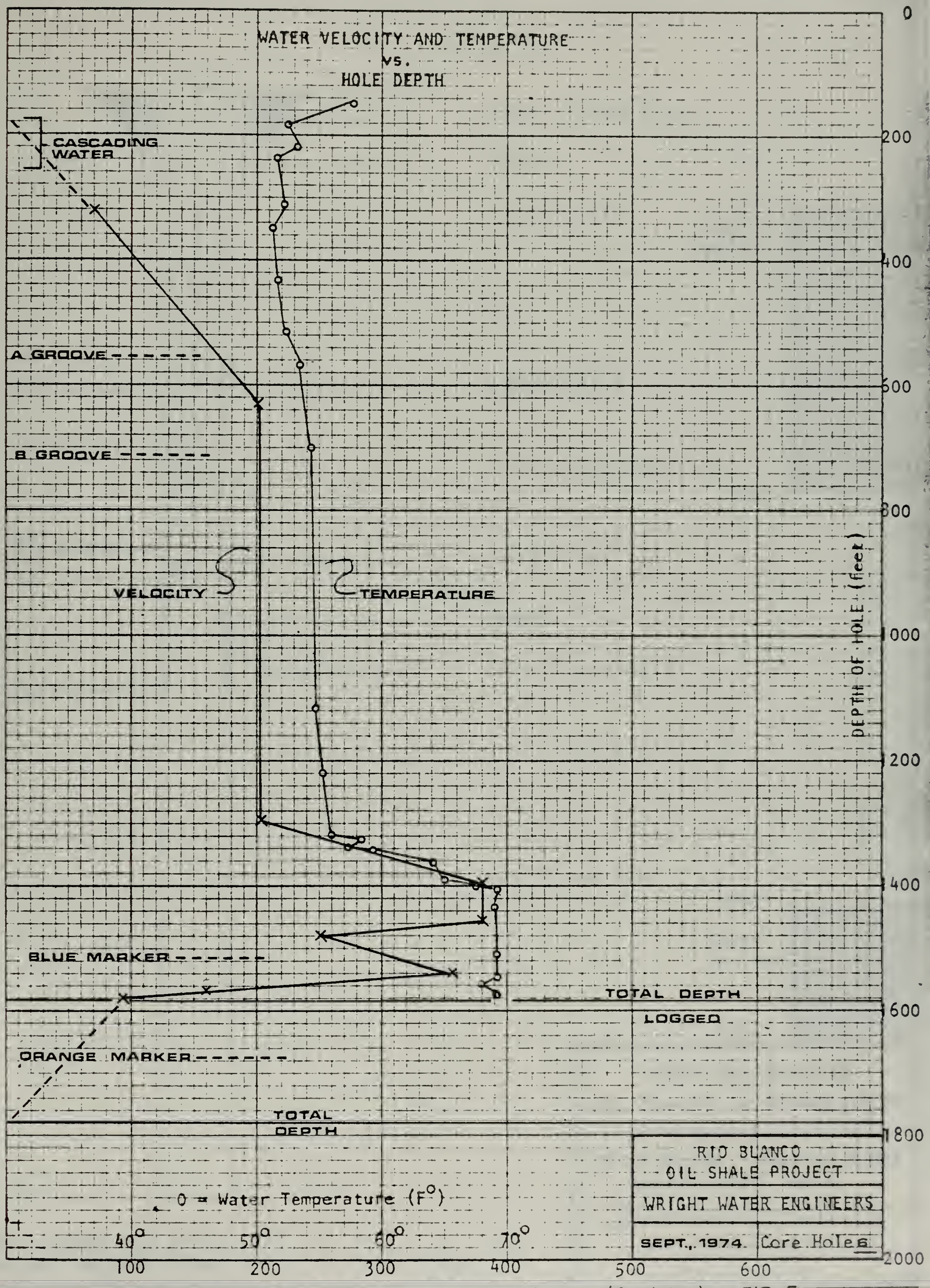
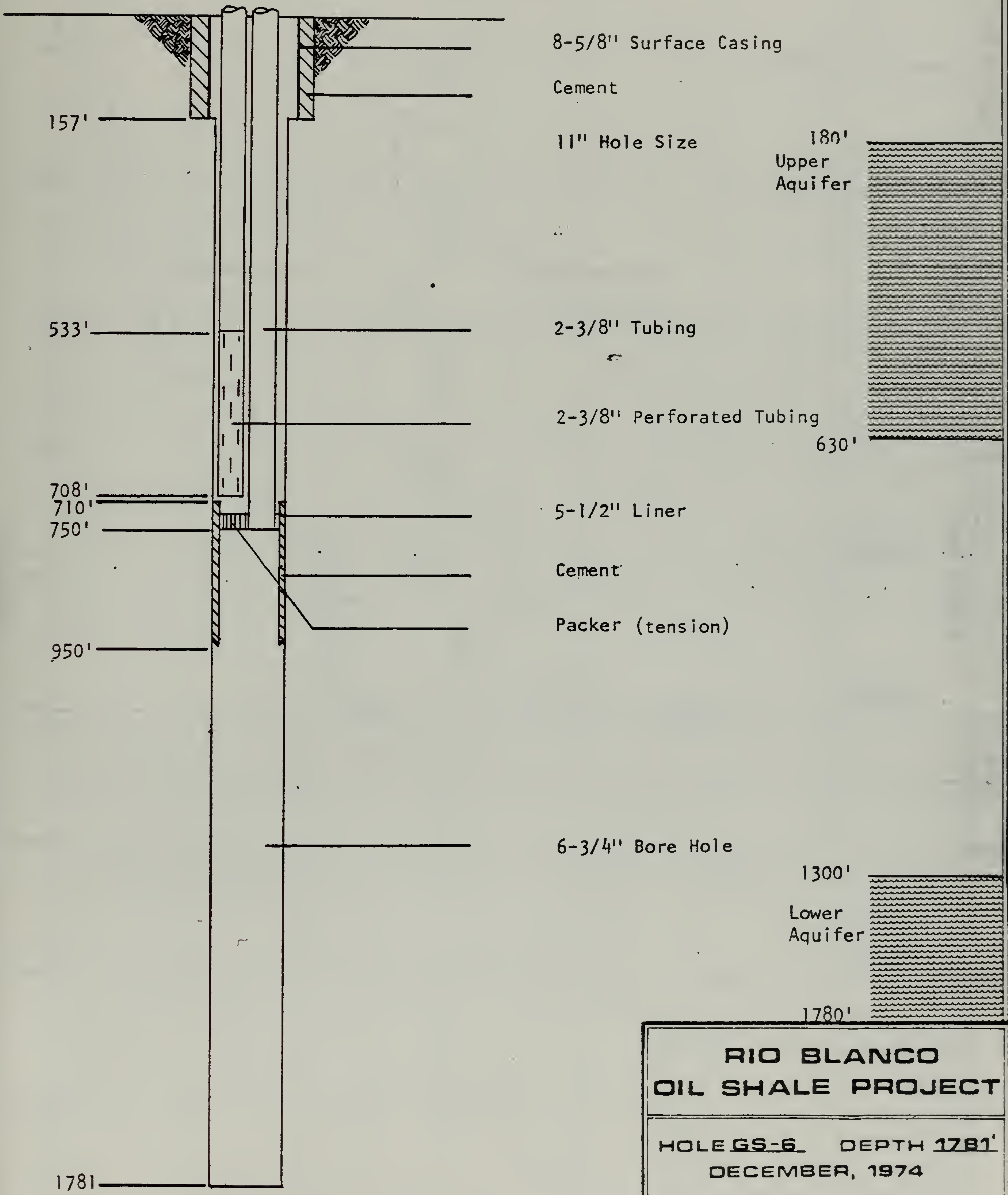

INFORMAL RECOVERY TEST
T = 264 (530) / 334
= 420 gpd/ft
S.C = 530 / 2175
= 0.24 gpm/ft
T
DEPTH TO WATER (FEET)
450
500
550
600
650
700
750
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-6
PRESSURE BOMB TEST
DEPTH-1781
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 4



KEUFFEL & ESSER CO.



**RIO BLANCO
OIL SHALE PROJECT**

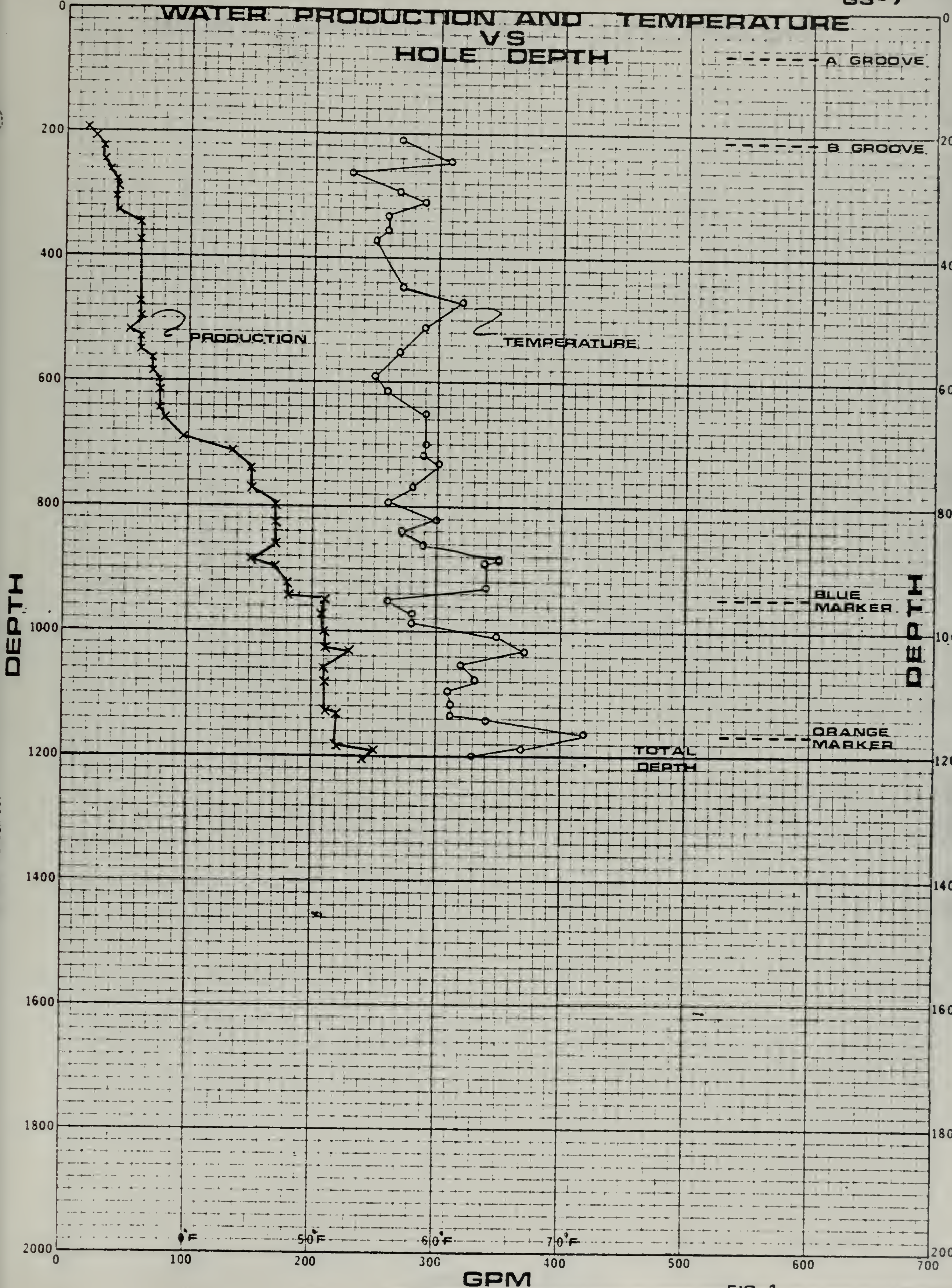
HOLE GS-6 DEPTH 1781'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

ERTICAL SCALE 1" - 200'
HORIZONTAL SCALE 1"-1' 0"

FIG. 7

GS-7



WATER PRODUCTION AND TEMPERATURE VS HOLE DEPTH

FIG. 1

KEUFFEL & ESSER CO.

GS-7

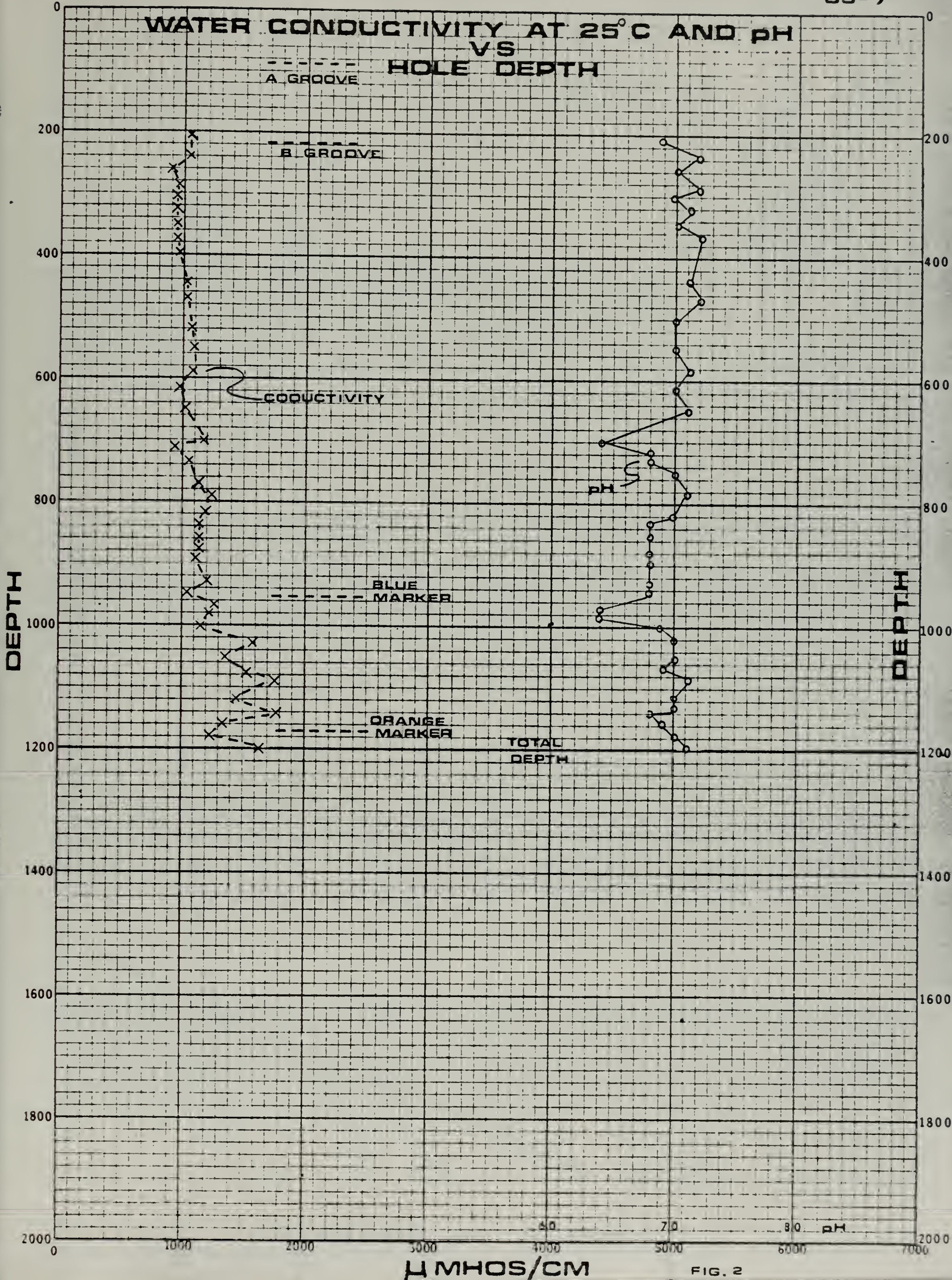


FIG. 2

KEUFFEL & ESSER CO.

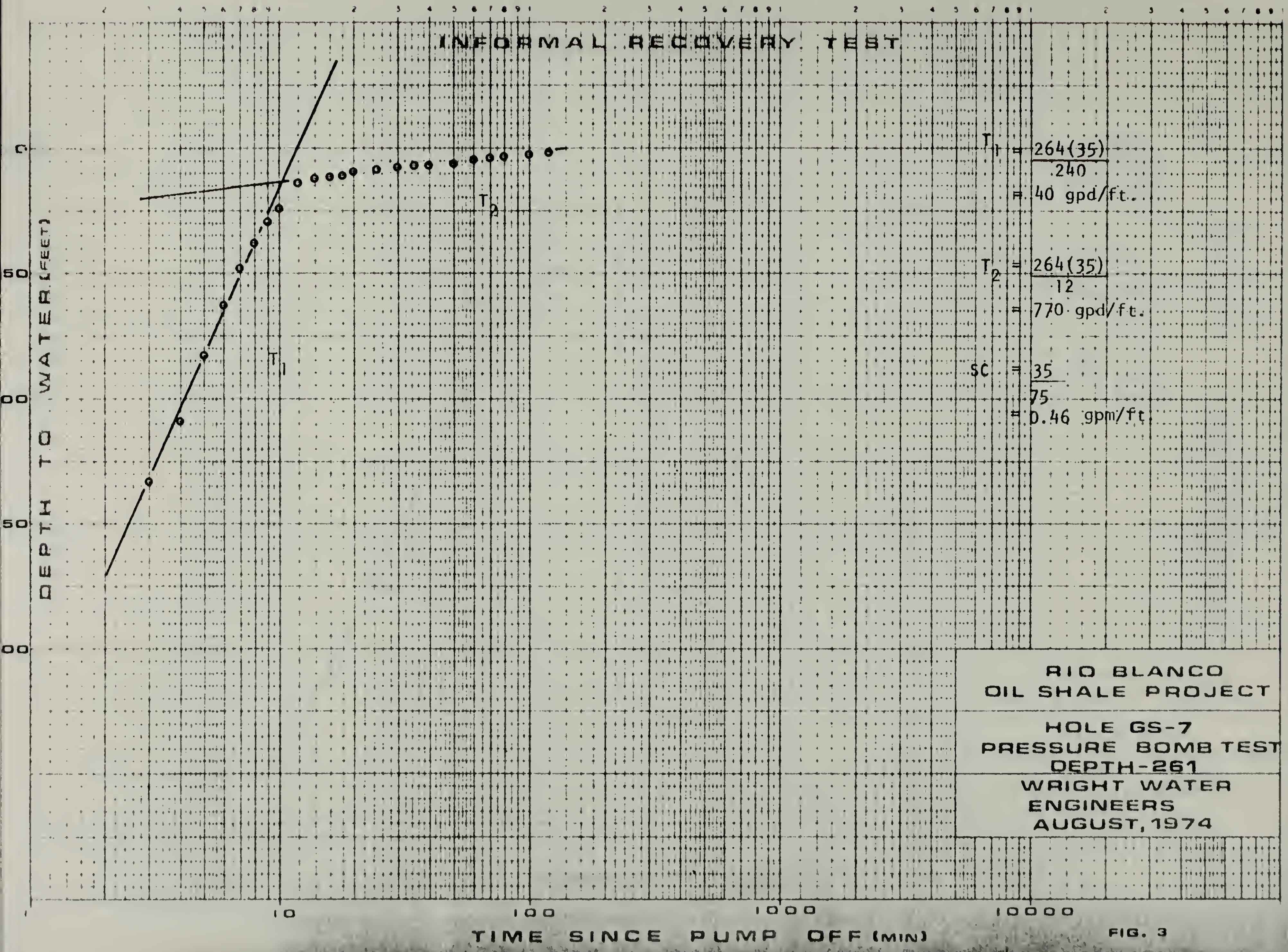
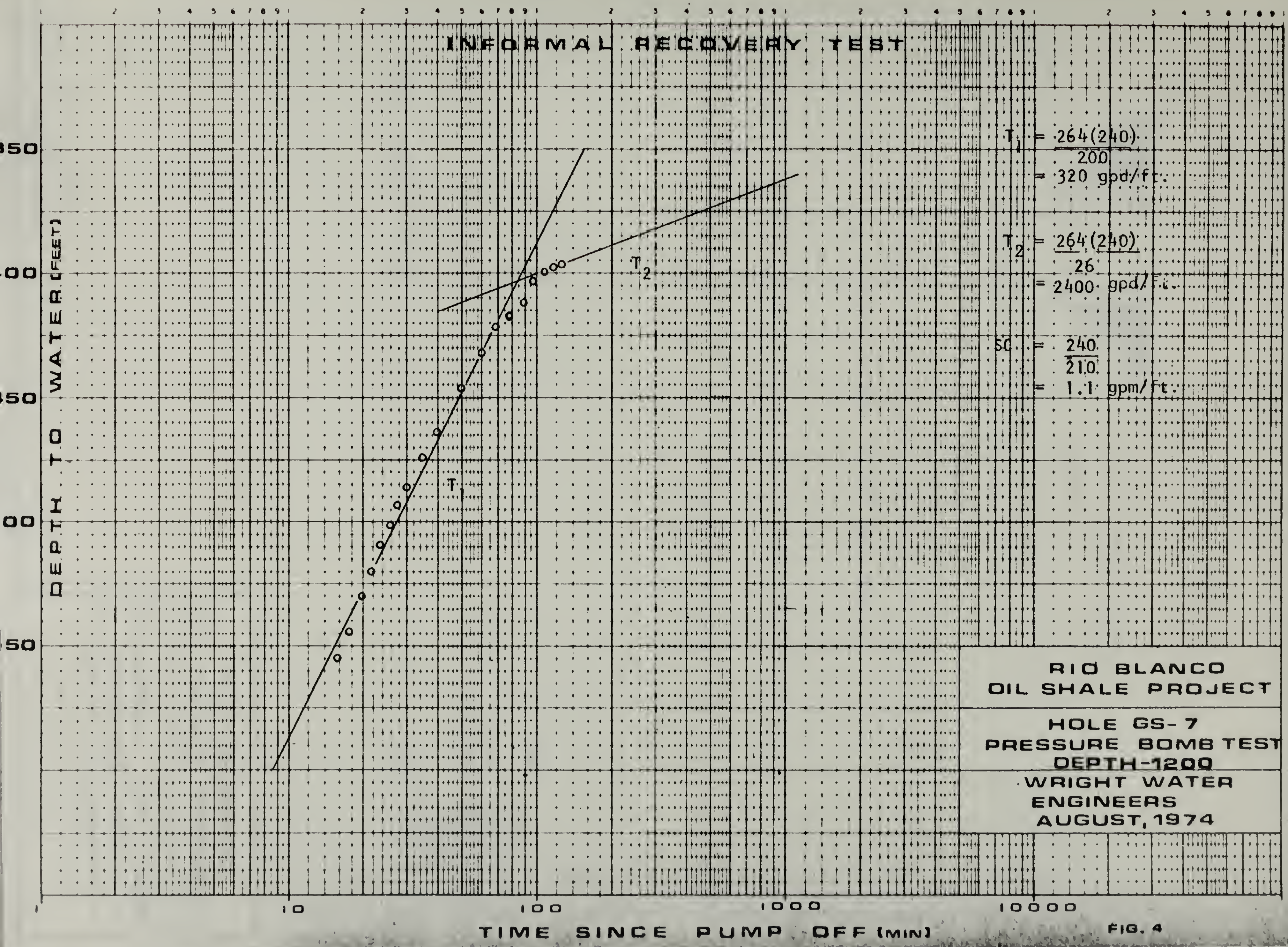

INFORMAL RECOVERY TEST
DEPTH TO WATER (FEET)
0
50
00
50
00
TIME SINCE PUMP OFF (MIN)
10
100
1000
10000
T1
T2
T1 = 264(35)/240 = 40 gpd/ft.
T2 = 264(35)/12 = 770 gpd/ft.
SC = 35/75 = 0.46 gpm/ft
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-7
PRESSURE BOMB TEST
DEPTH-261
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3



$T_1 = \frac{264(240)}{200}$

$= 320$ gpd/ft.

$T_2 = \frac{264(240)}{26}$

$= 2400$ gpd/ft.

$SC = \frac{240}{210}$

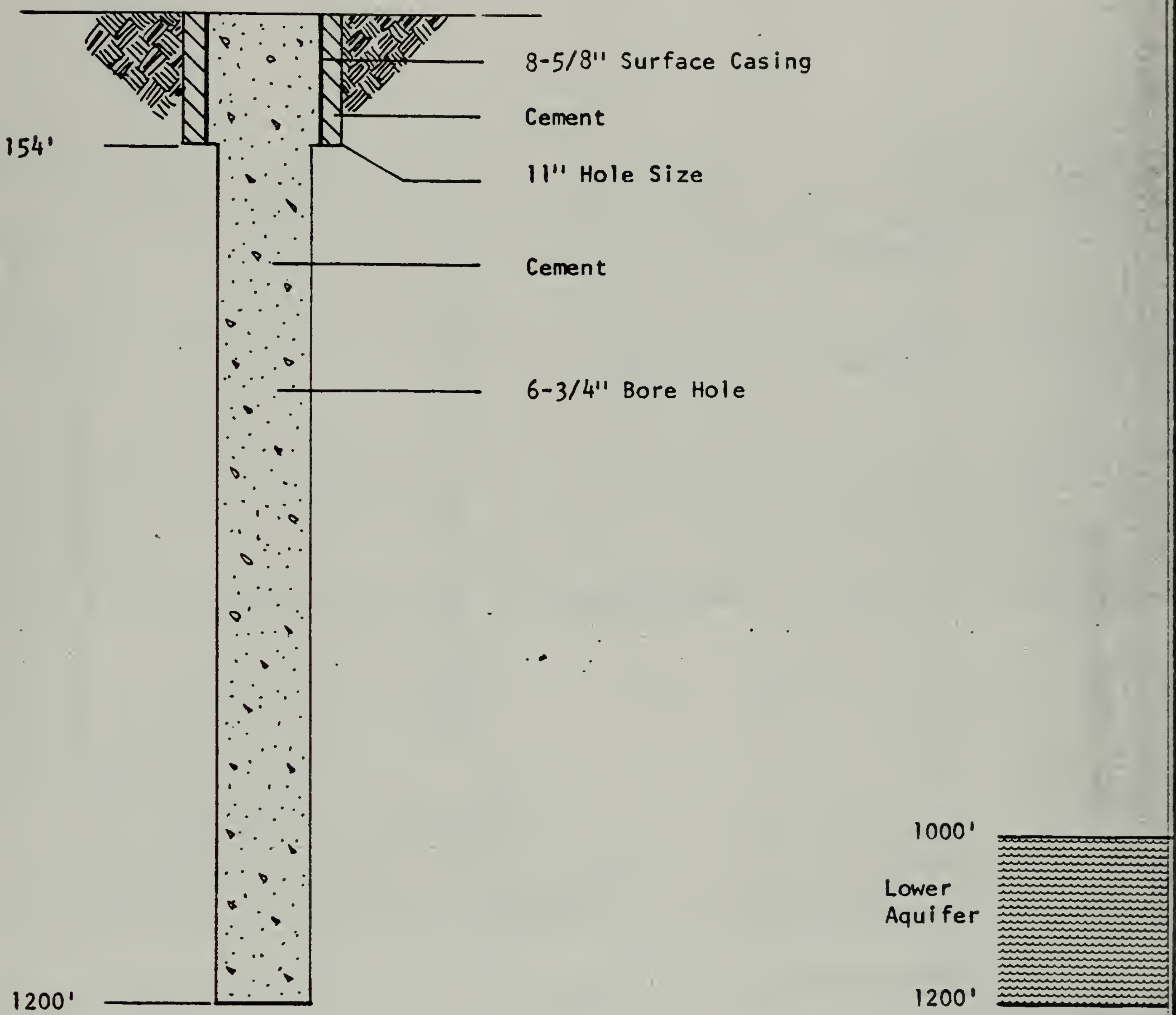
$= 1.1$ gpm/ft.

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-7
PRESSURE BOMB TEST
DEPTH-1200

WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 4



VERITICAL SCALE 1"~200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-7 DEPTH 1200
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 802[illegible]

GS- 8

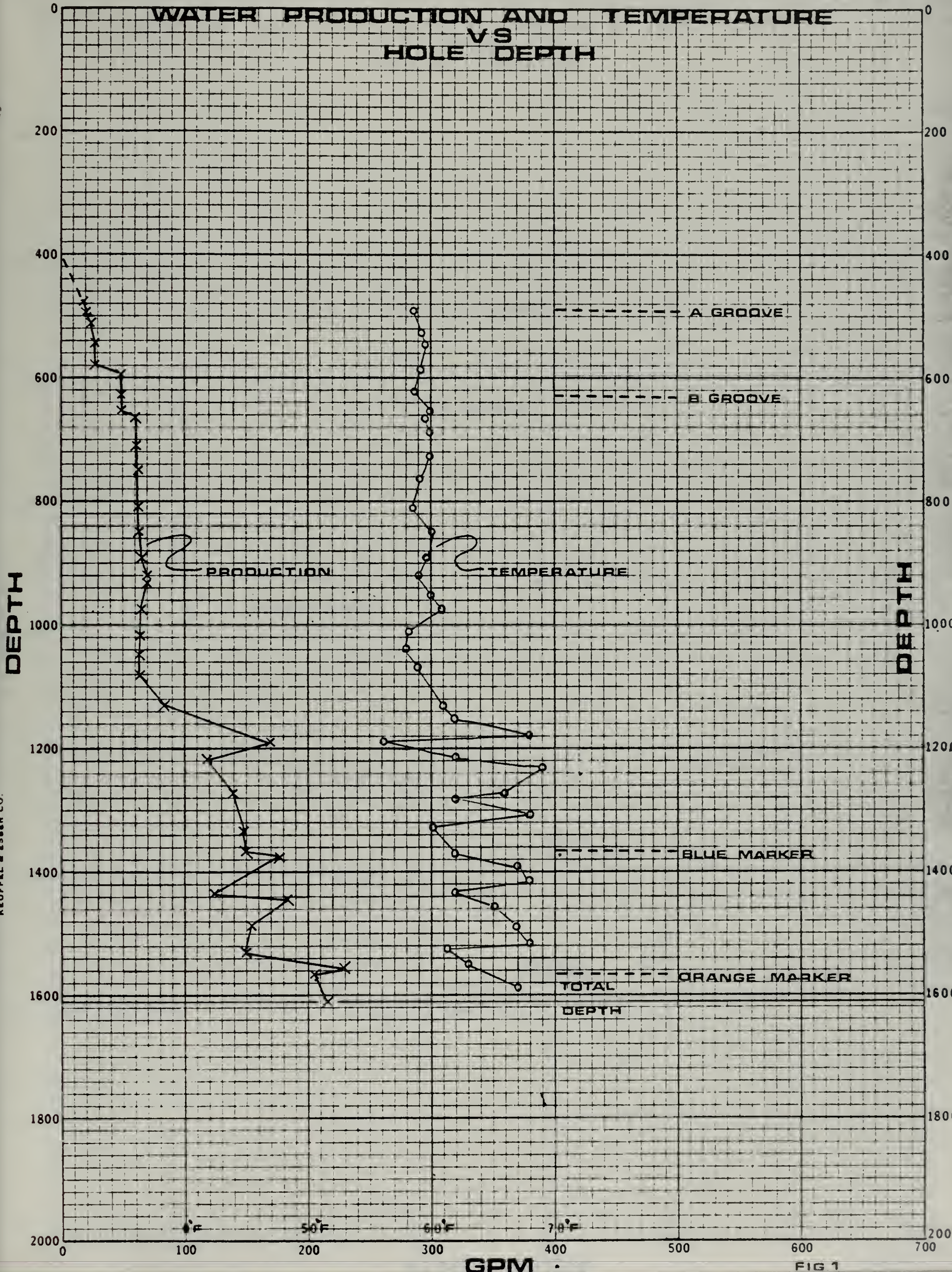

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
PRODUCTION
TEMPERATURE
BLUE MARKER
ORANGE MARKER
TOTAL
DEPTH
0°F
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM
KEUFFEL & ESSER CO.

FIG 1

GS- 8

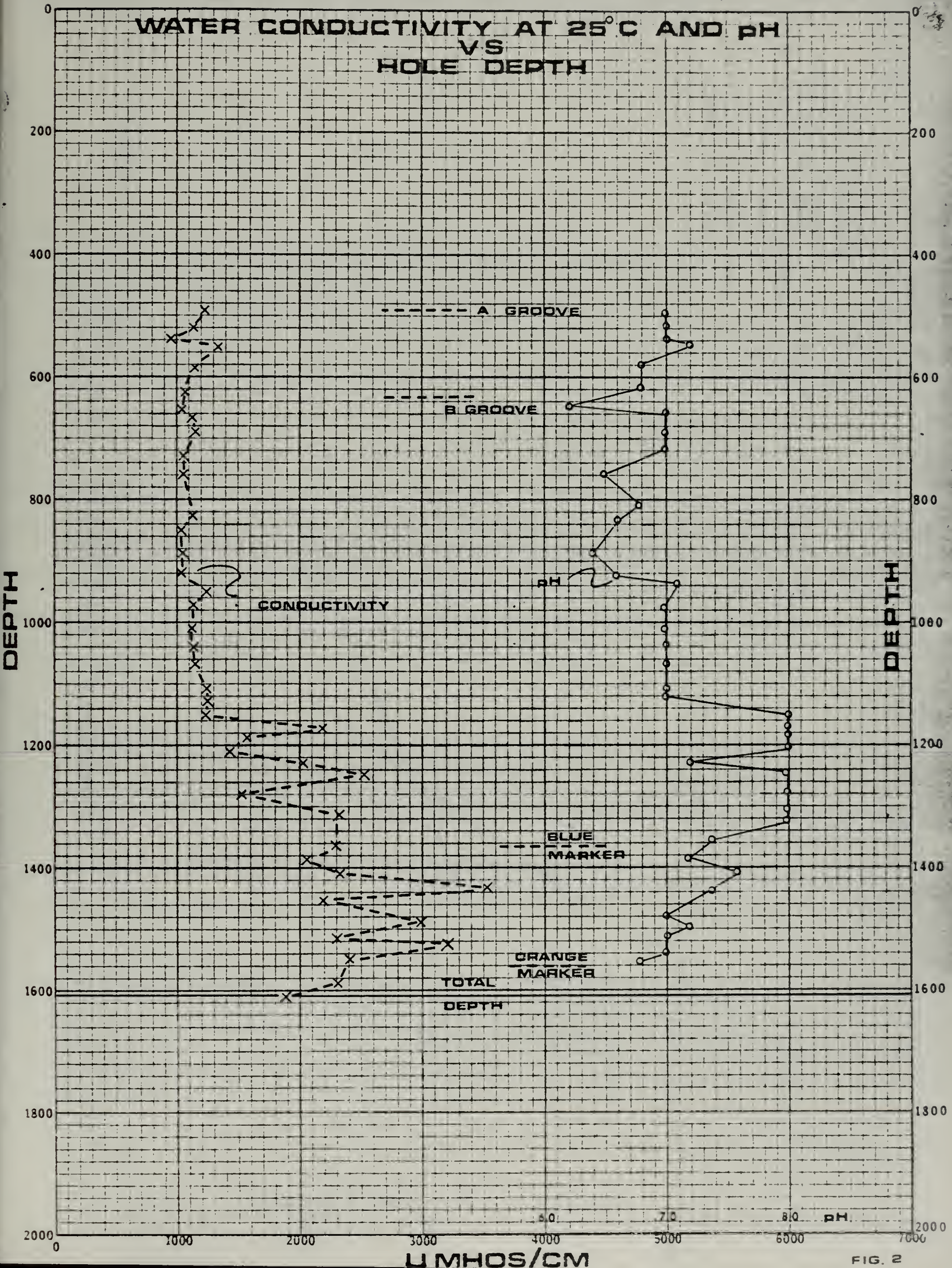

WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH
DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
pH
CONDUCTIVITY
BLUE
MARKER
ORANGE
MARKER
TOTAL
DEPTH
0
1000
2000
3000
4000
5000
6000
7000
6.0
7.0
8.0
pH
U MHOS/CM

FIG. 2

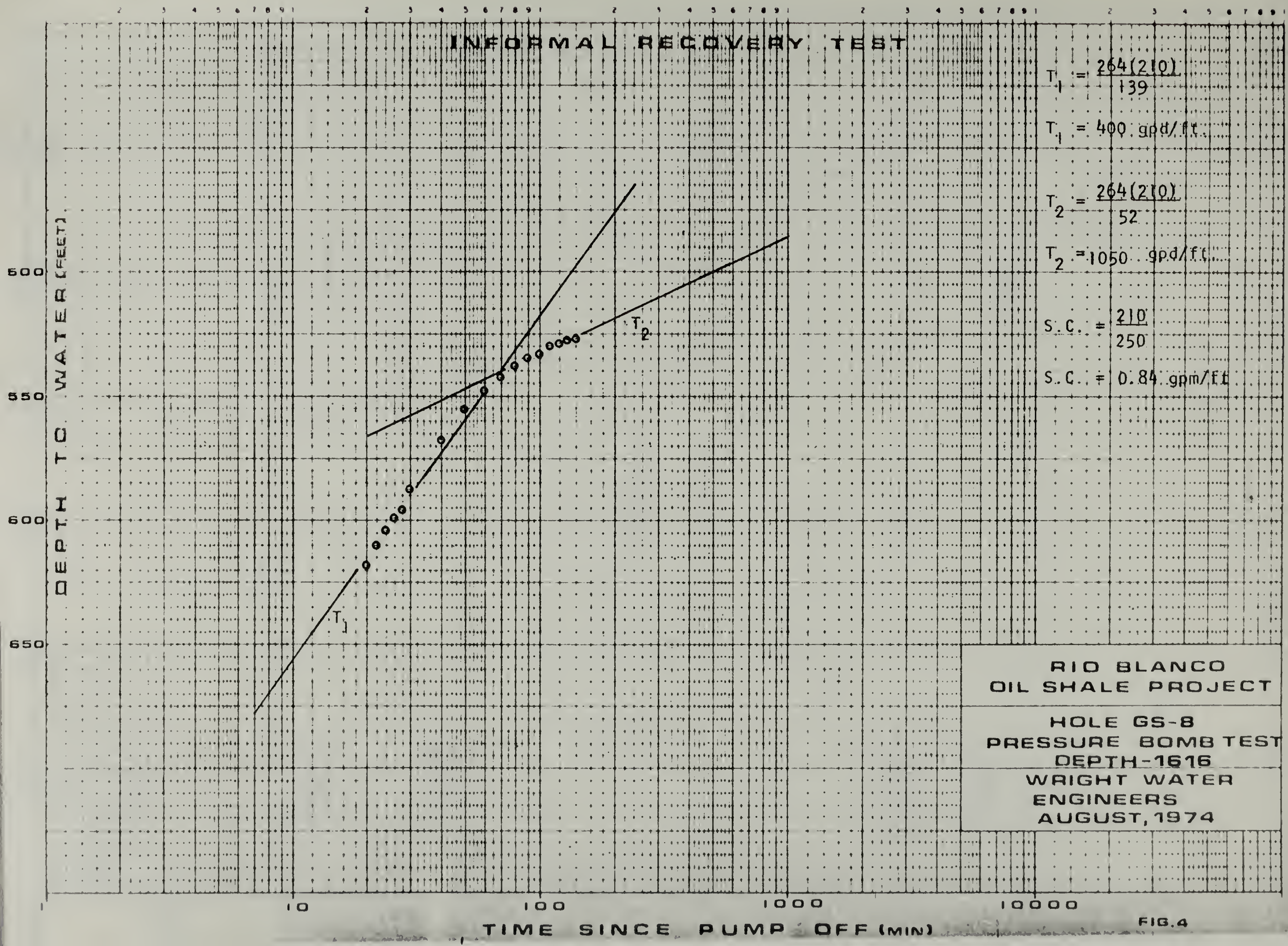

INFORMAL RECOVERY TEST
T1 = 264(210) / 139
T1 = 400 gpd/ft.
T2 = 264(210) / 52
T2 = 1050 gpd/ft.
S.C. = 210 / 250
S.C. = 0.84 gpm/ft
T1
T2
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-8
PRESSURE BOMB TEST
DEPTH-1616
WRIGHT WATER
ENGINEERS
AUGUST, 1974
DEPTH TO WATER (FEET)
500
550
600
650
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)

FIG.4

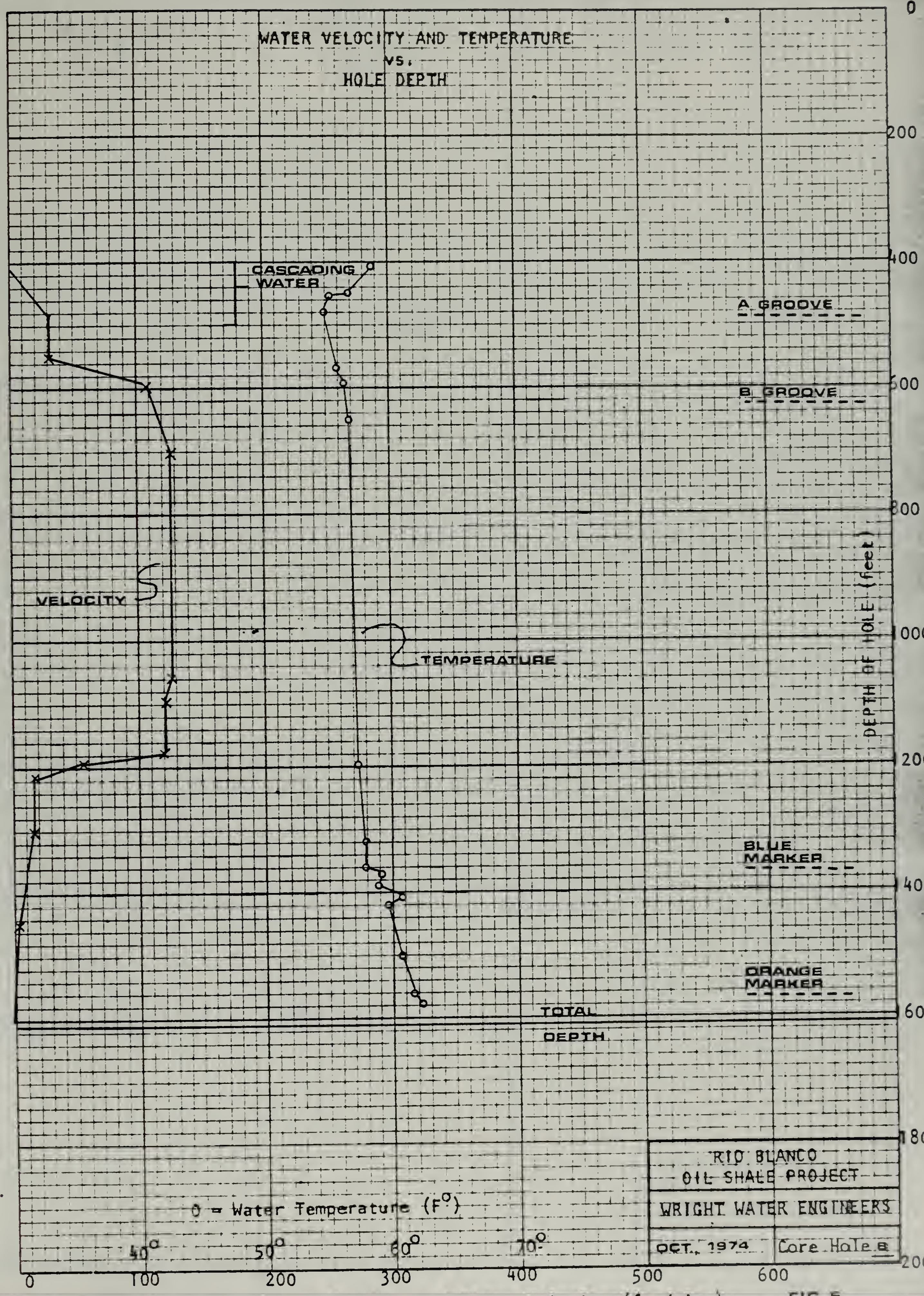

WATER VELOCITY AND TEMPERATURE
VS.
HOLE DEPTH
CASCADING WATER
A GROOVE
B GROOVE
VELOCITY
TEMPERATURE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
DEPTH OF HOLE (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0 = Water Temperature (F°)
40°
50°
60°
70°
0
100
200
300
400
500
600
RIO BLANCO
OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT. 1974
Core Hole 8

FIG 5

WATER MOVEMENT VS. HOLE DEPTH

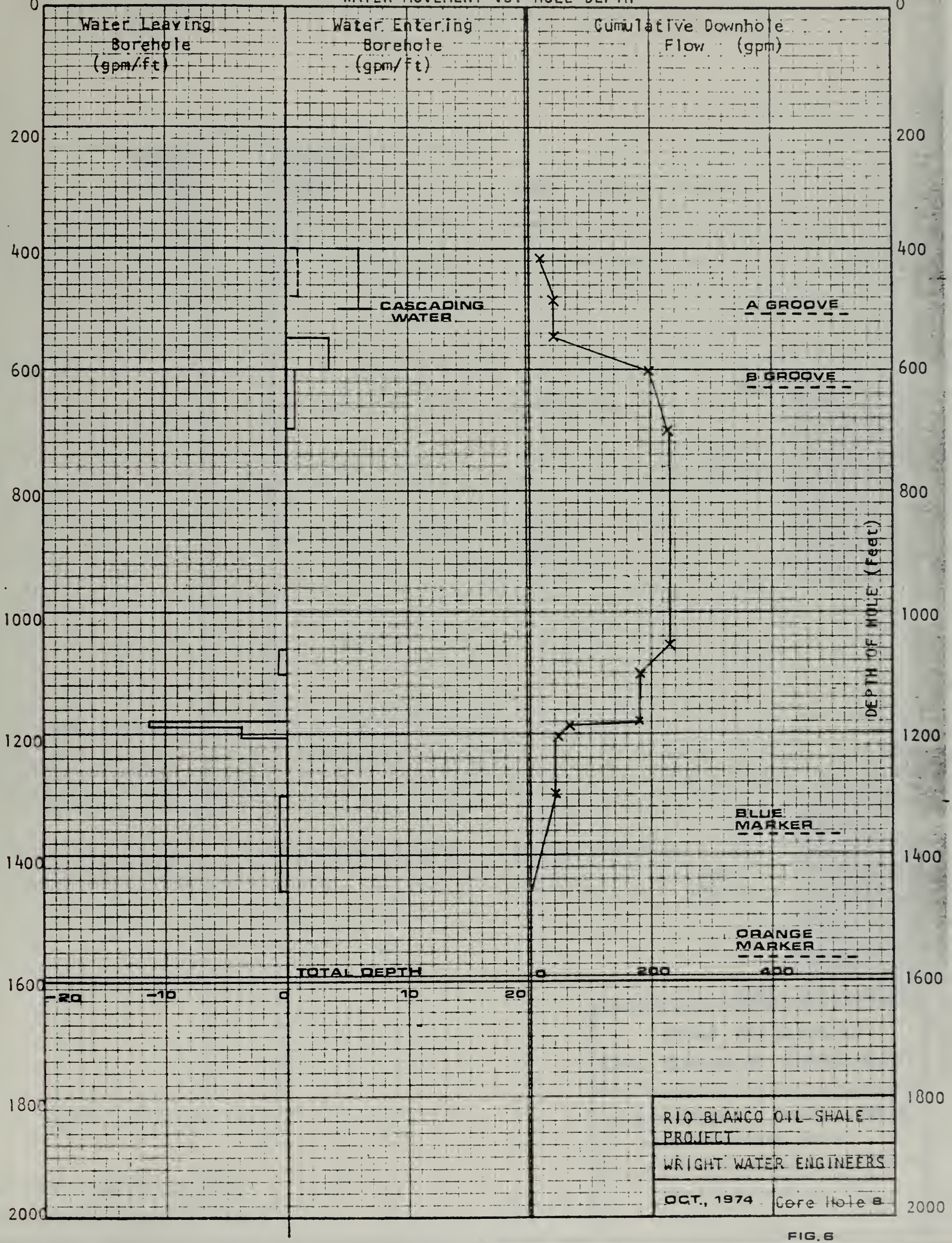
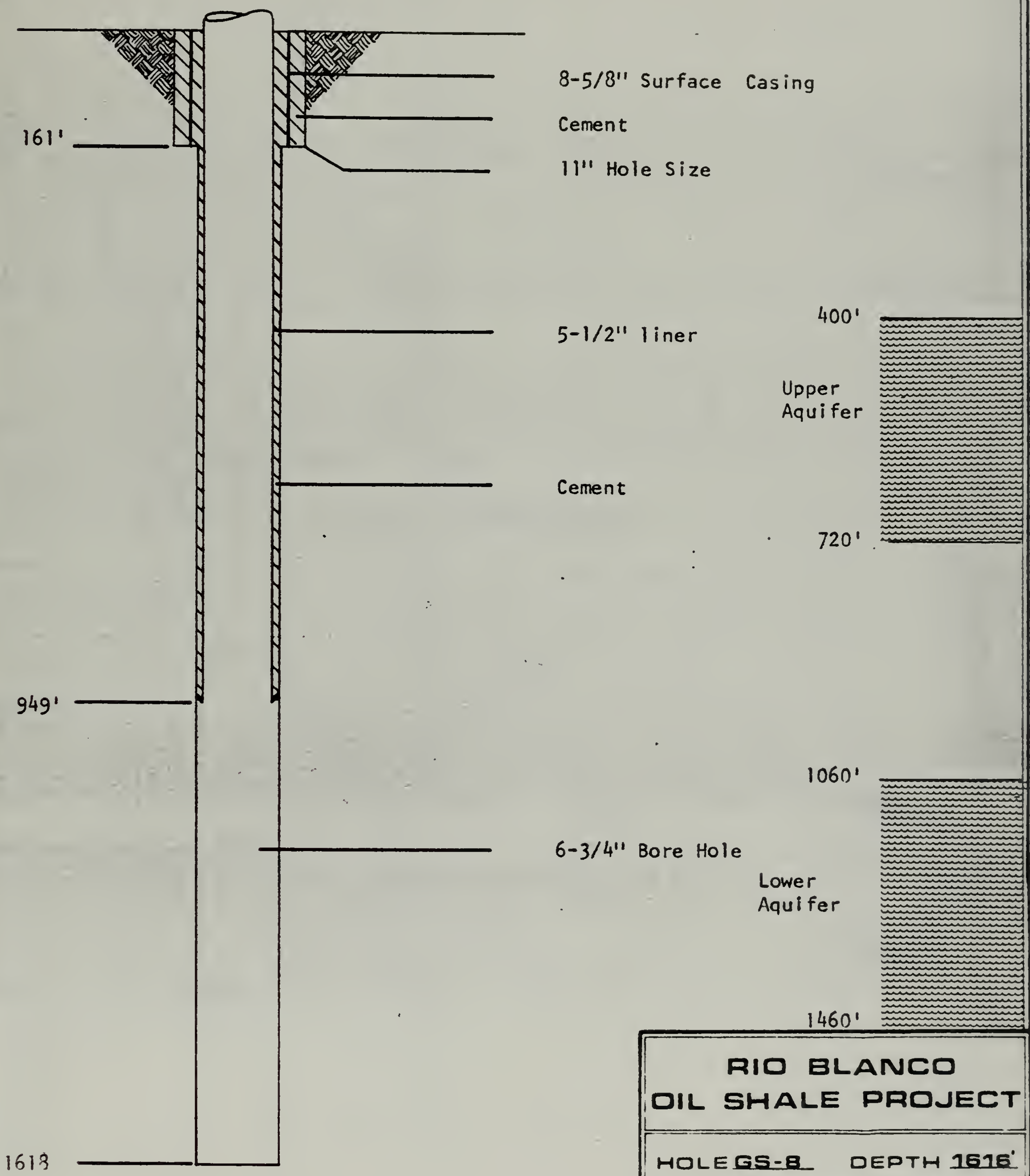


FIG. 6

KEUFFEL & ESSER CO



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-8 DEPTH 1616'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT S [illegible]
DENVER COLORADO 802

ERITICAL SCALE 1" – 200'
ORIZONTAL SCALE 1" - 1'-0"

FIG. 7

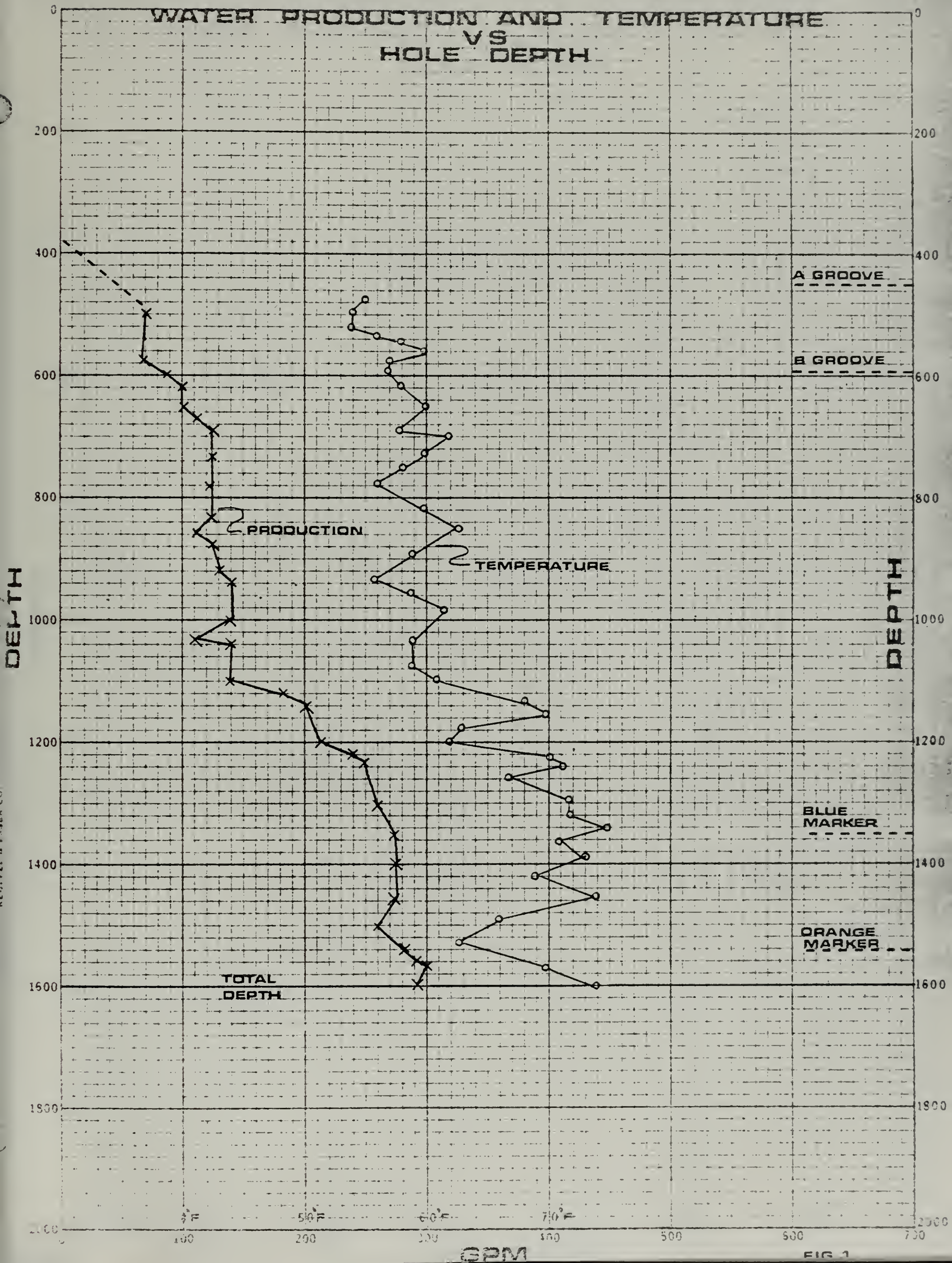
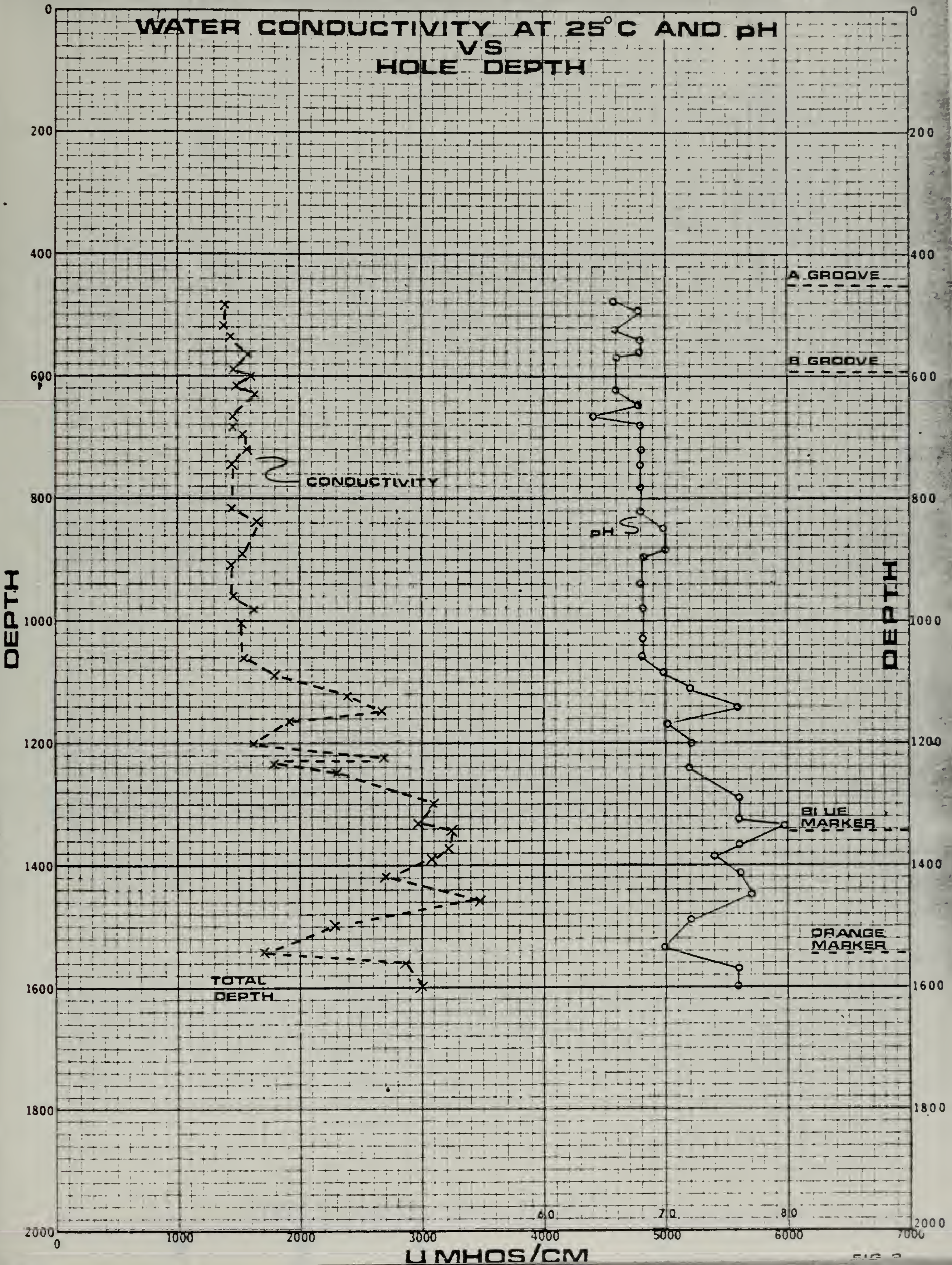

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
PRODUCTION
TEMPERATURE
TOTAL DEPTH
40°F
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM

FIG. 1

GS-9



K+E 10 X 10 TO THE INCH 46 0703
7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

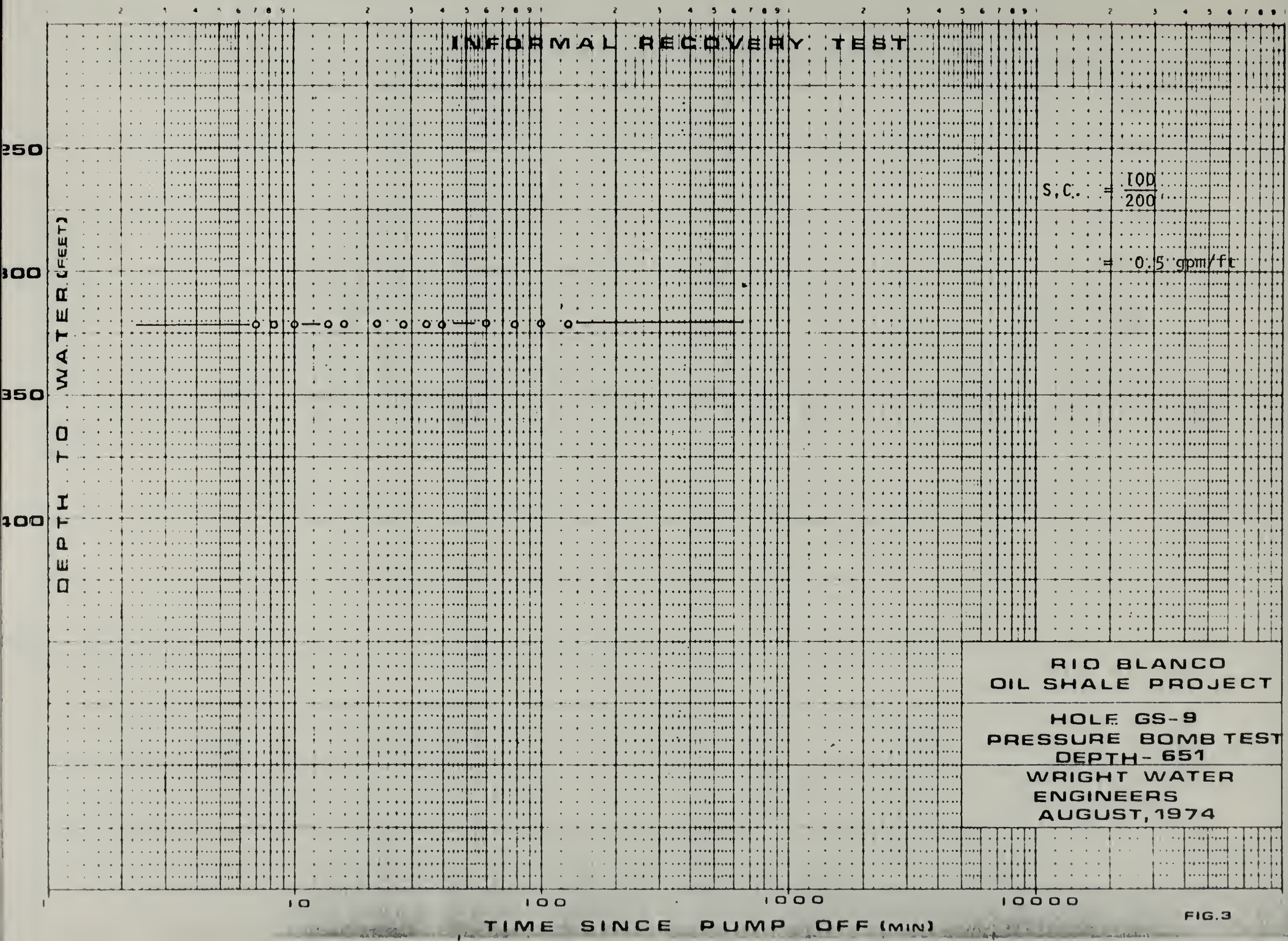

INFORMAL RECOVERY TEST
DEPTH TO WATER (FEET)
250
300
350
400
TIME SINCE PUMP OFF (MIN)
1
10
100
1000
10000
S.C. = 100/200
= 0.5 gpm/ft
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-9
PRESSURE BOMB TEST
DEPTH - 651
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.3

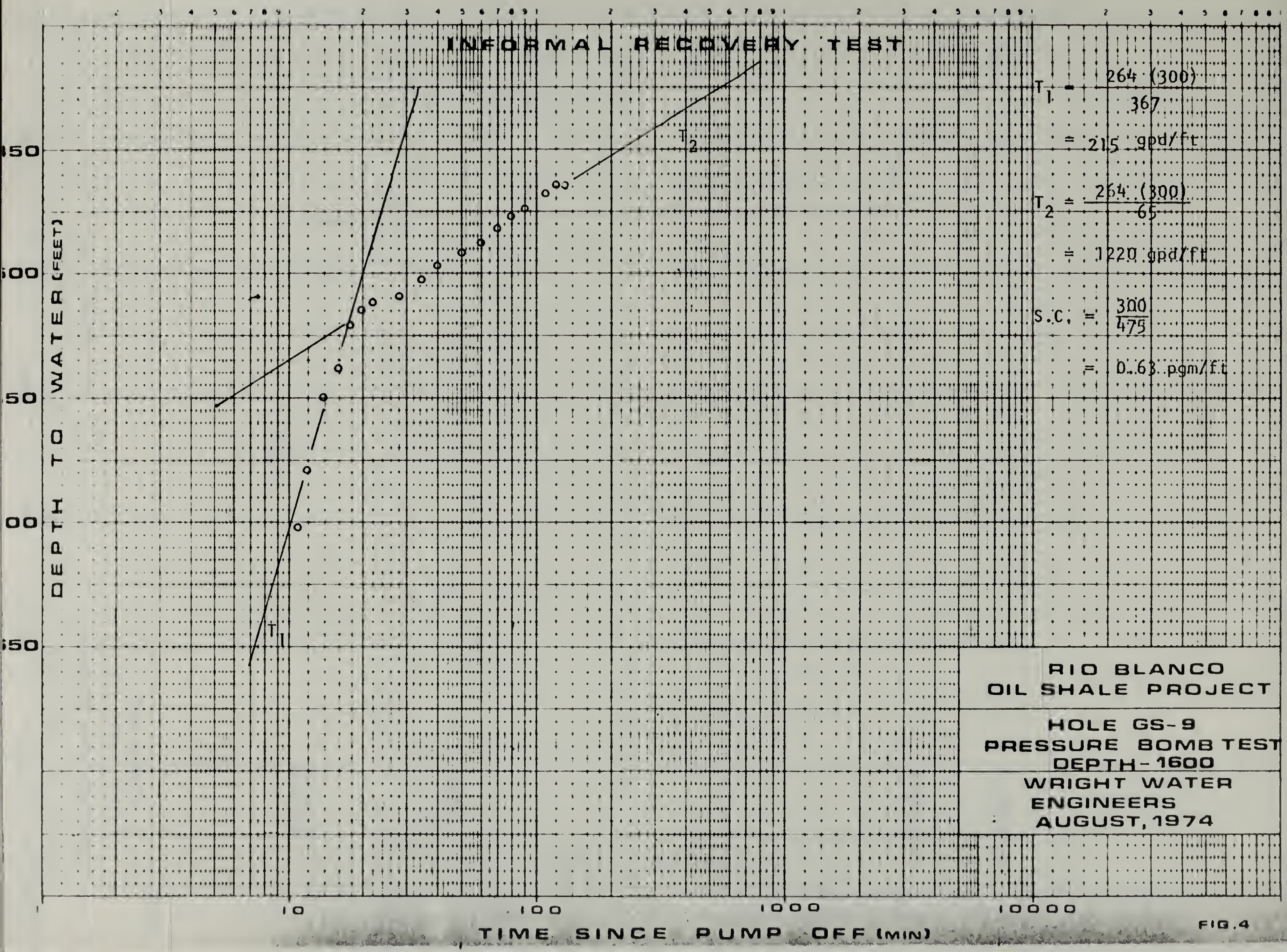
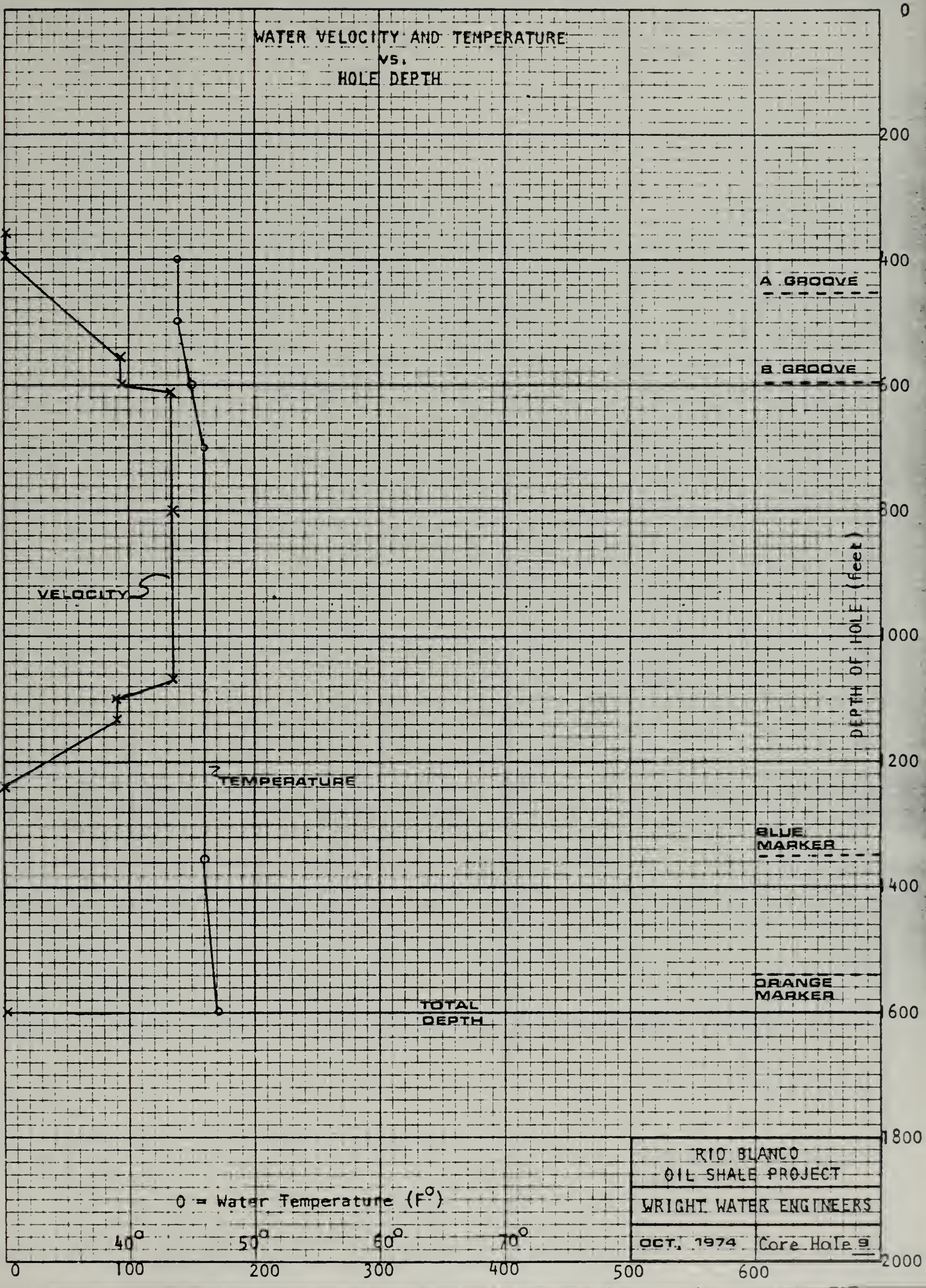
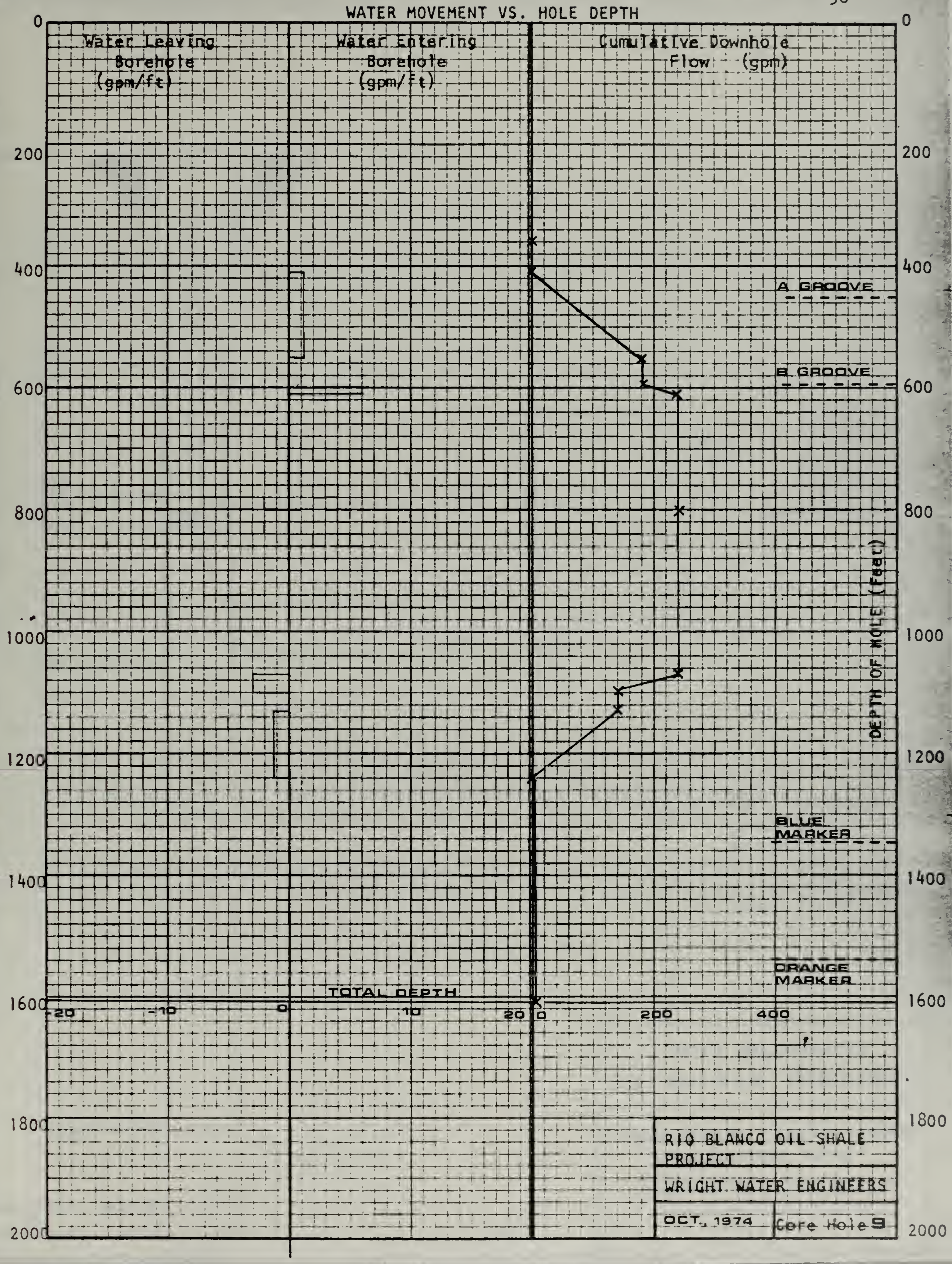
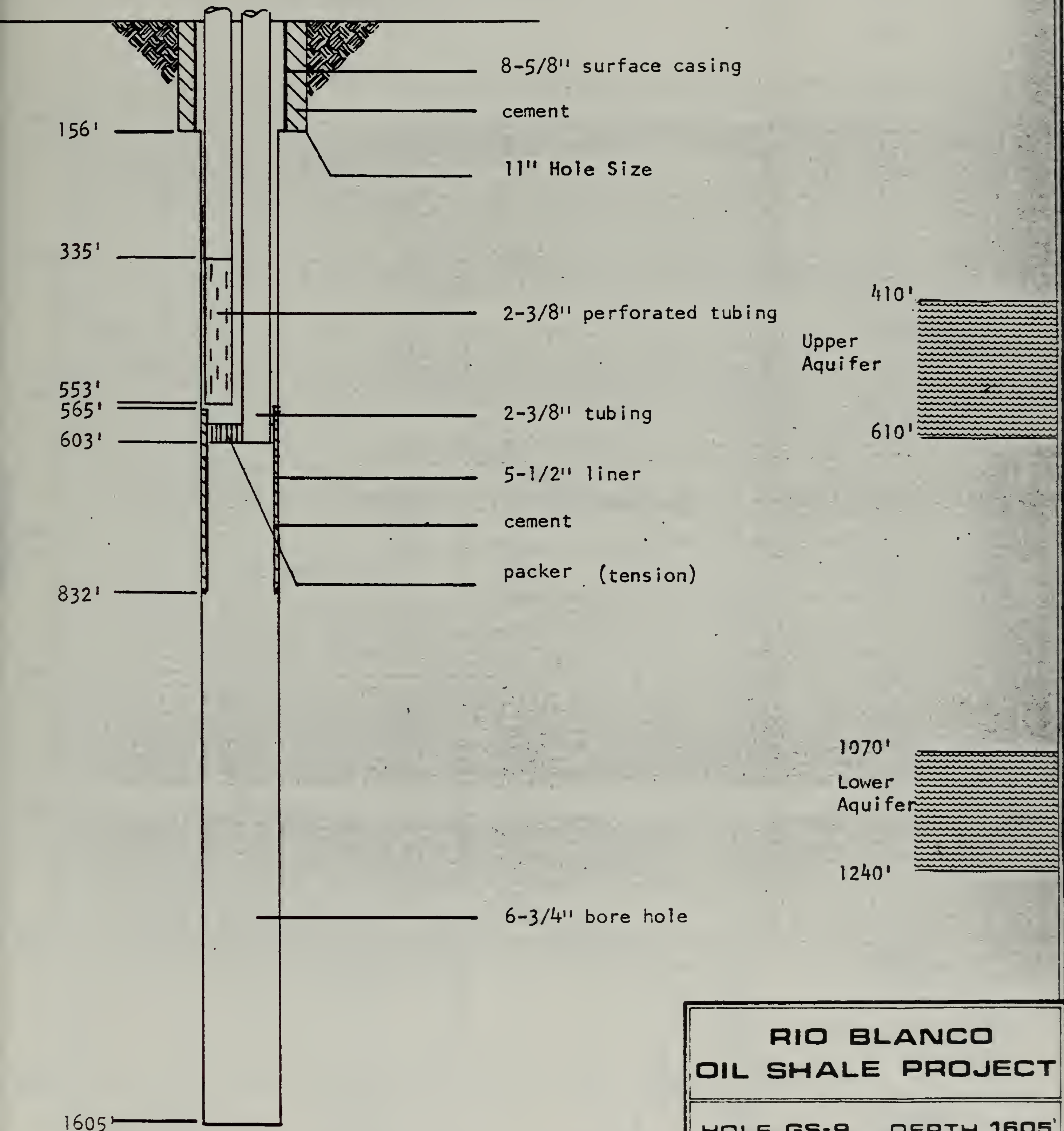

INFORMAL RECOVERY TEST
T1 = 264 (300) / 367
= 215 gpd/ft
T2 = 264 (300) / 65
= 1220 gpd/ft
S.C. = 300 / 475
= 0.63 pgm/ft
T2
T1
50
00
50
00
50
DEPTH TO WATER (FEET)
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-9
PRESSURE BOMB TEST
DEPTH-1600
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.4


WATER VELOCITY AND TEMPERATURE
vs.
HOLE DEPTH
A GROOVE
B GROOVE
VELOCITY
TEMPERATURE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
DEPTH OF HOLE (feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0 = Water Temperature (F°)
40°
50°
60°
70°
0
100
200
300
400
500
600
RIO BLANCO
OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT. 1974
Core Hole 9



KEUFFEL & ESSER CO.



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-9 DEPTH 1605'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 8021

ERITICAL SCALE 1"-200'
IORIZONTAL SCALE 1"-1'-0"

FIG. 7

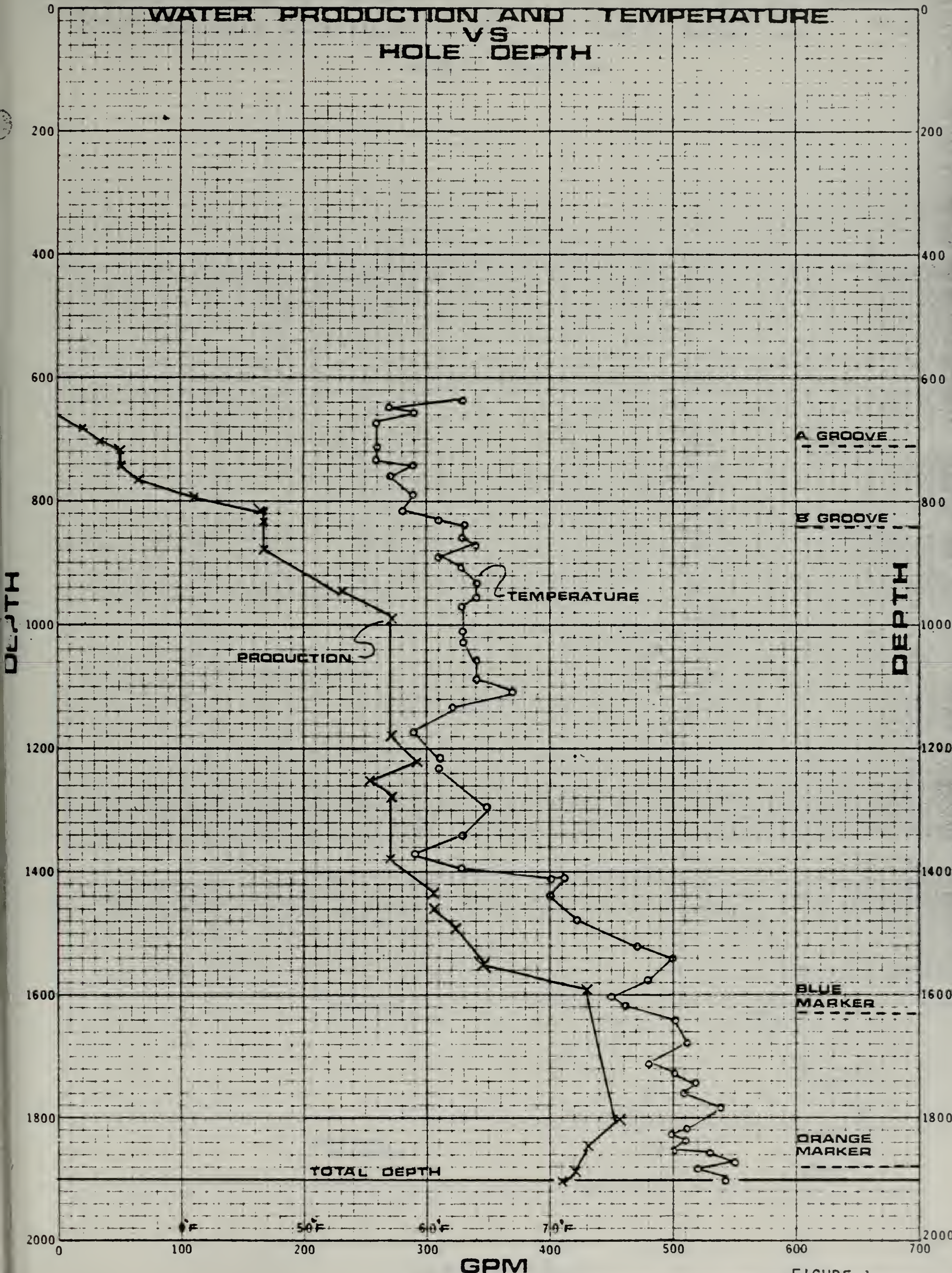

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
TEMPERATURE
PRODUCTION
°F
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM

FIGURE 1

GS-10

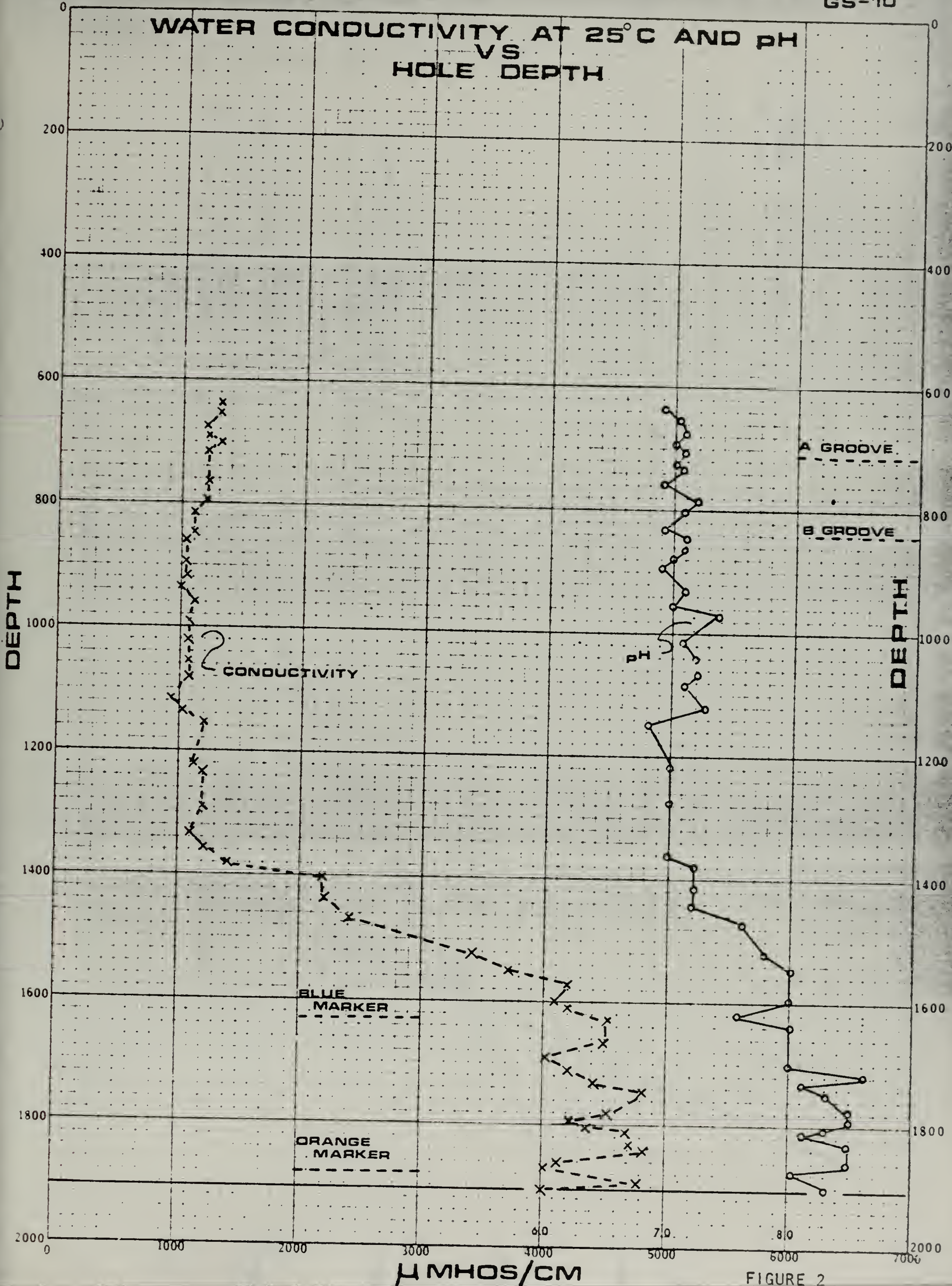


FIGURE 2

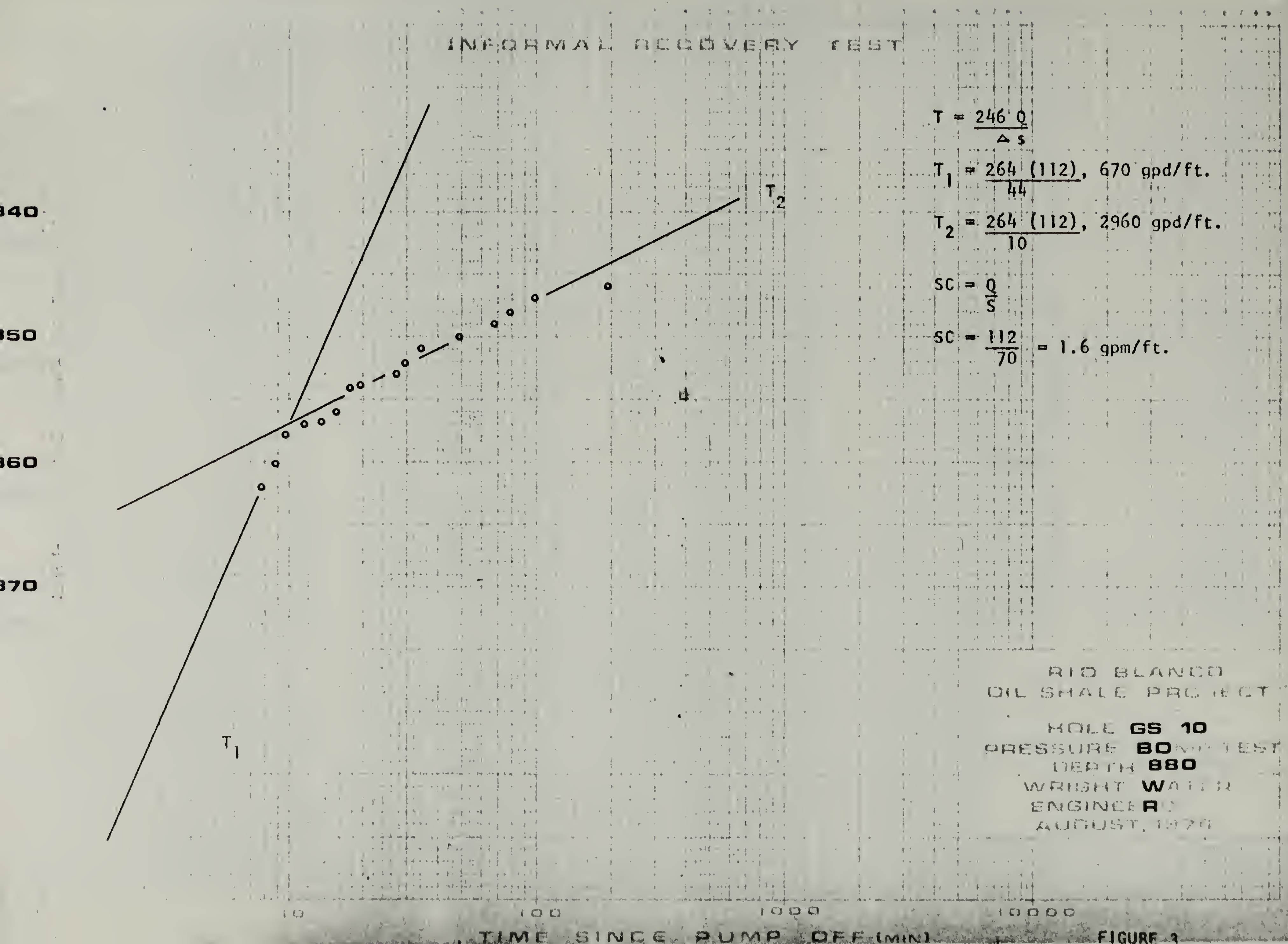

INFORMAL RECOVERY TEST
T = 246 Q / Δs
T1 = 264 (112) / 44, 670 gpd/ft.
T2 = 264 (112) / 10, 2960 gpd/ft.
SC = Q / S
SC = 112 / 70 = 1.6 gpm/ft.
T2
T1
340
350
360
370
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS 10
PRESSURE BOMB TEST
DEPTH 880
WRIGHT WATER
ENGINEERS
AUGUST, 1976

FIGURE 3

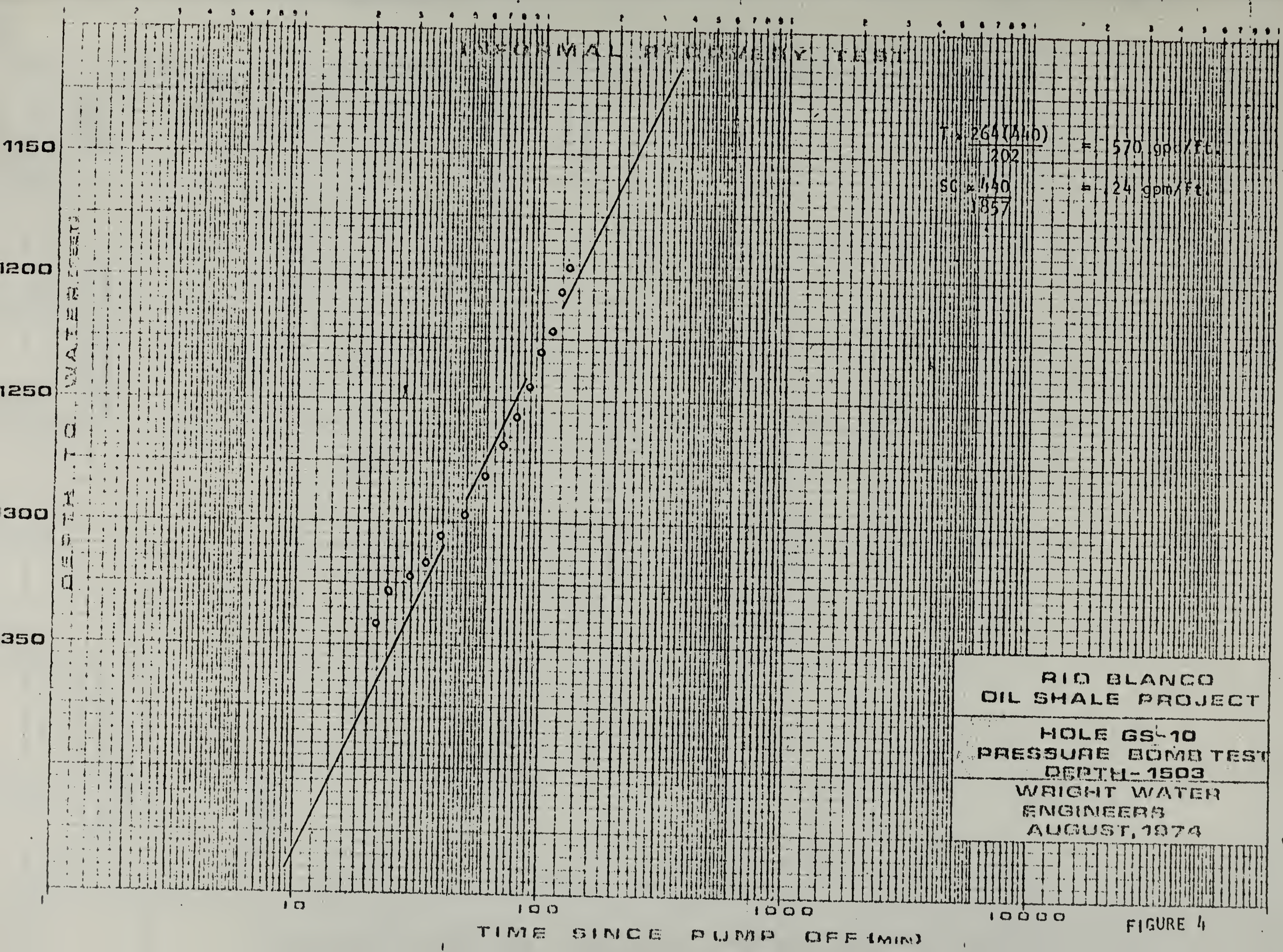
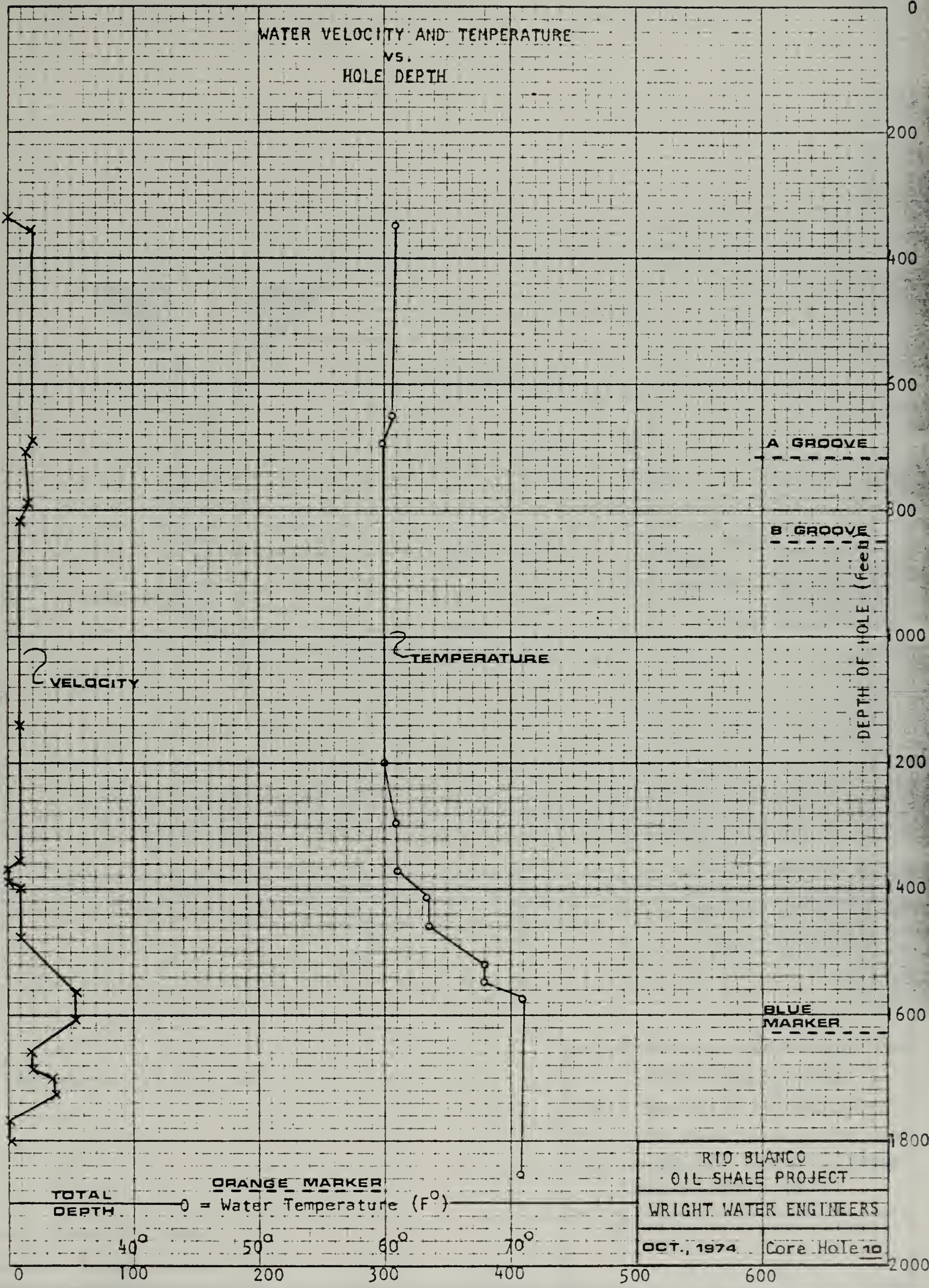
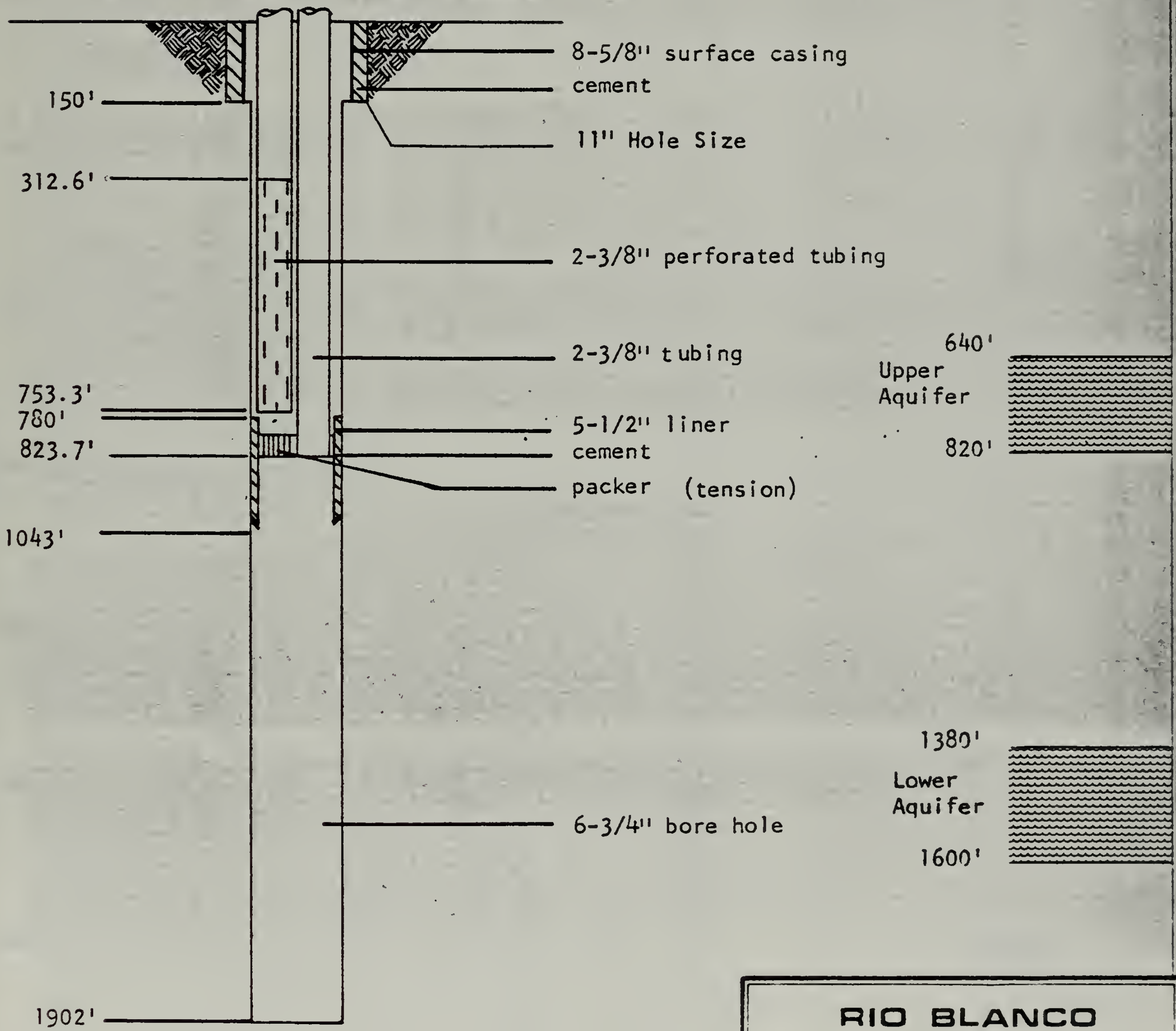

ABNORMAL RECOVERY TEST
$T = \frac{264(440)}{202}$ = 570 gpm/ft.
$SC = \frac{440}{1857}$ = .24 gpm/ft.
DEPTH TO WATER (FEET)
1150
1200
1250
1300
1350
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-10
PRESSURE BOMB TEST
DEPTH-1503
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIGURE 4



K&E 10 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-10 DEPTH 1902'
DECEMBER, 1974

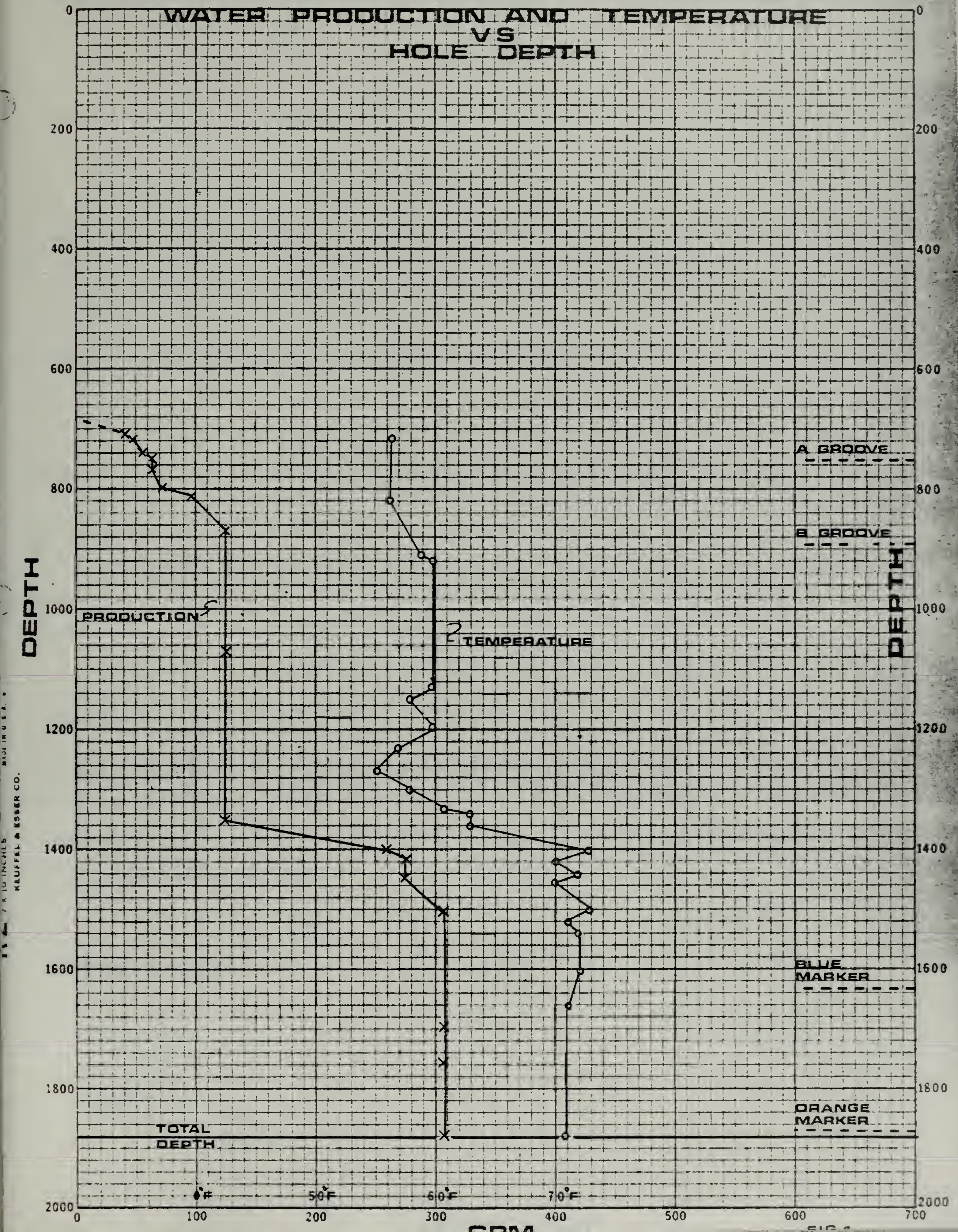
WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT [illegible]
DENVER COLORADO [illegible]

VERTICAL SCALE 1"-300'

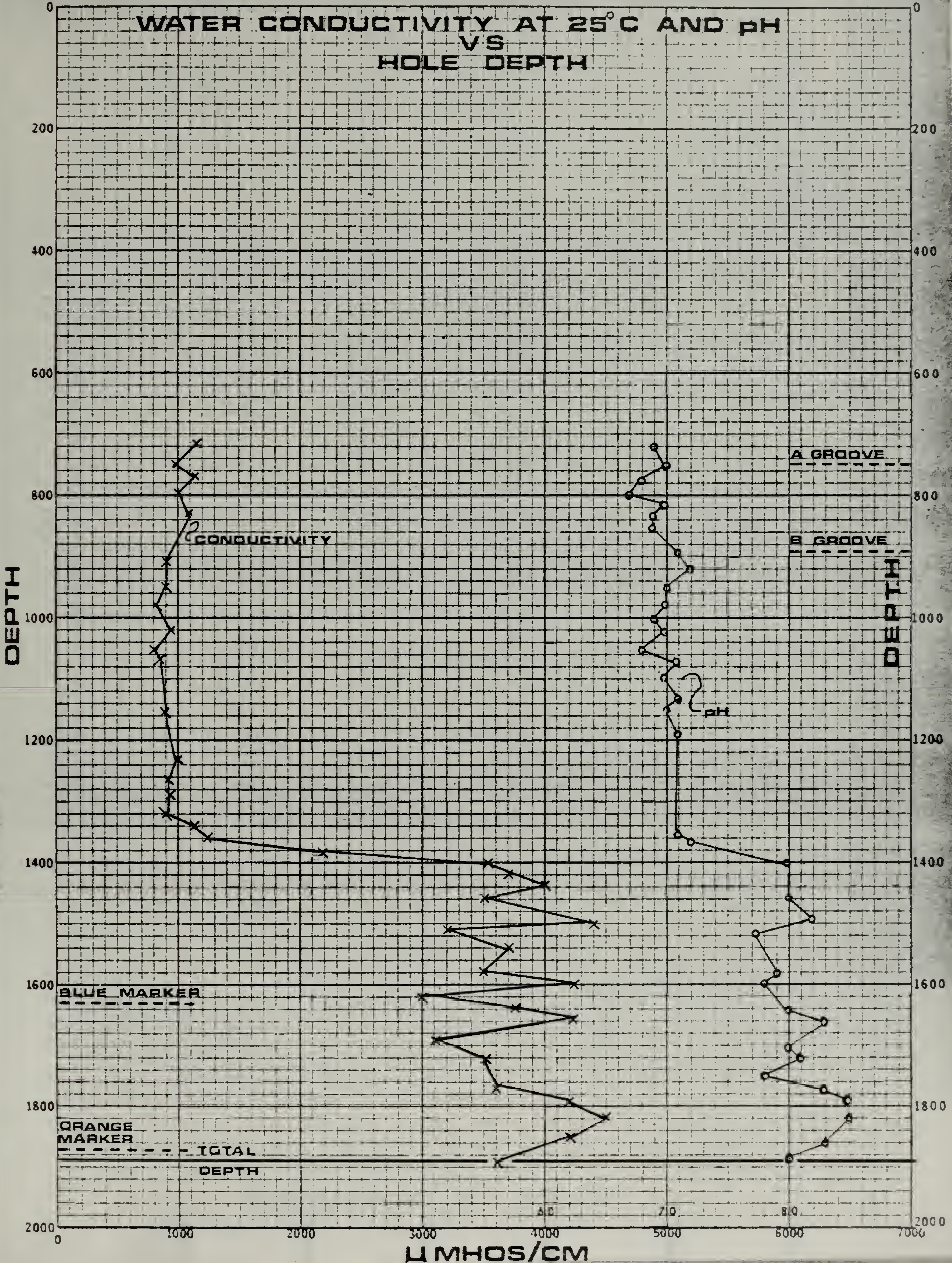
HORIZONTAL SCALE 1"-1' 0"

FIG. 7

GS-11


WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
PRODUCTION
TEMPERATURE
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
°F
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM

GS-11



NO. 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

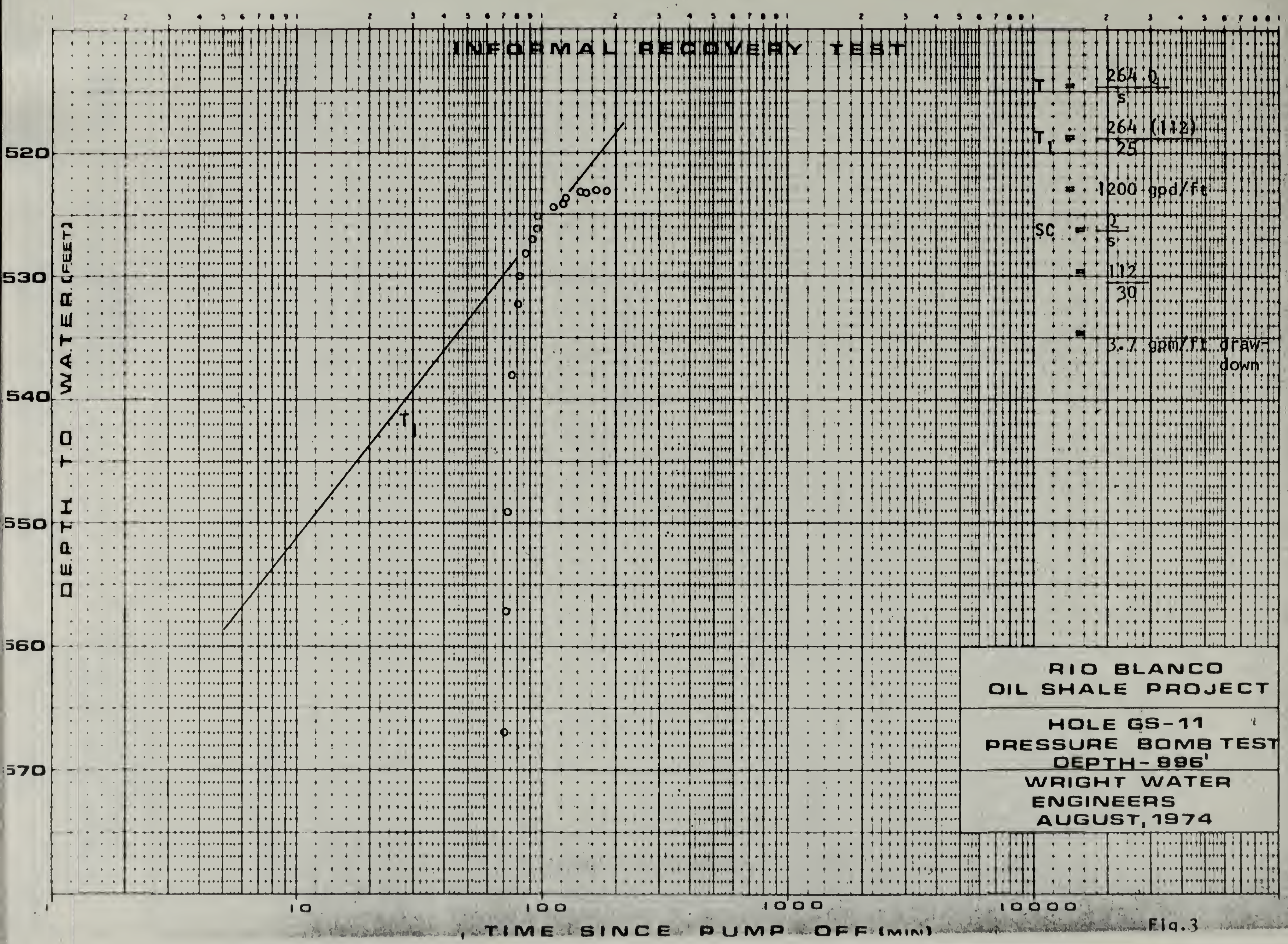
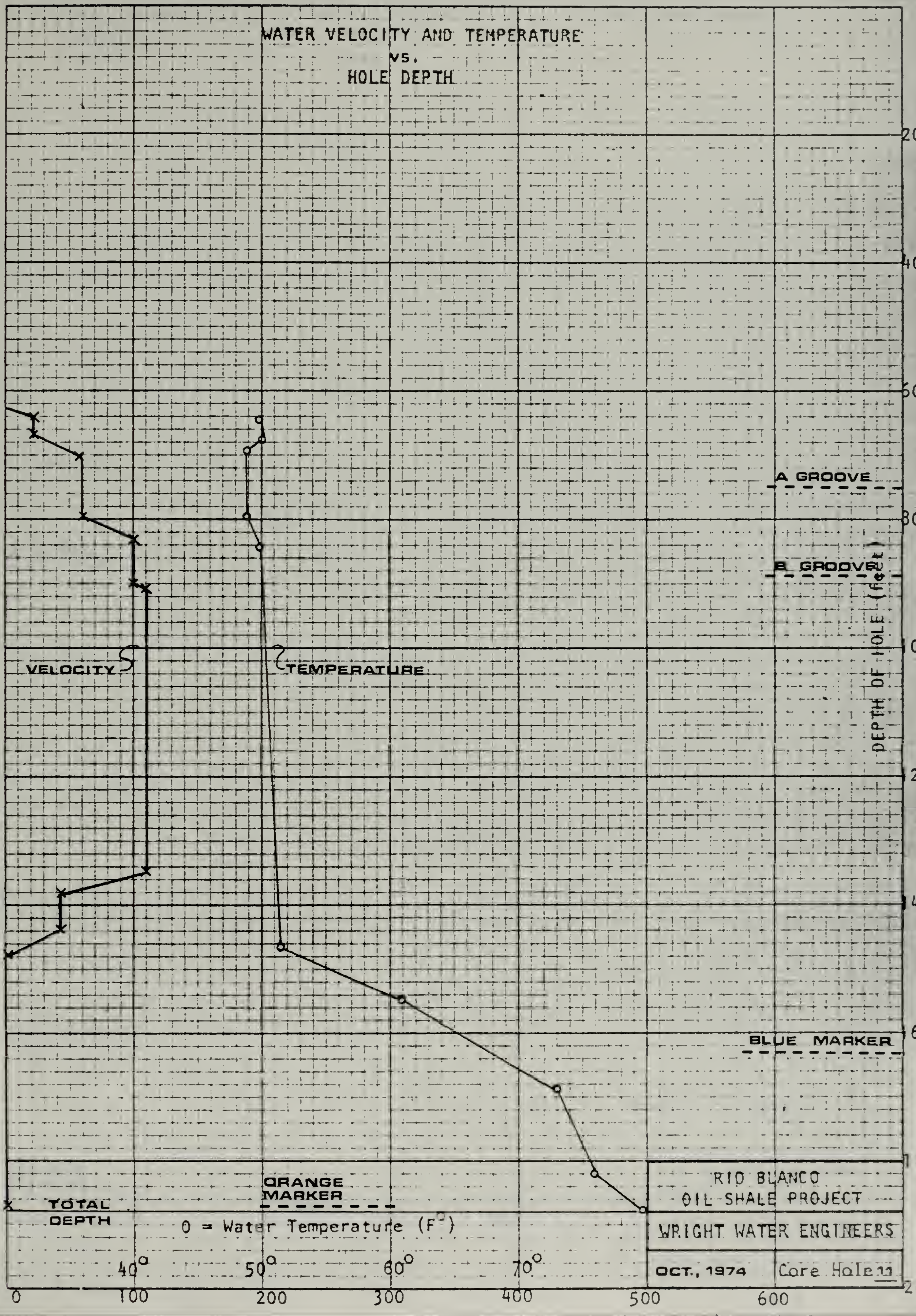

INFORMAL RECOVERY TEST
T = 264 Q / s
T₁ = 264 (112) / 25
= 1200 gpd/ft
SC = Q / s
= 112 / 30
= 3.7 gpm/ft draw-down
T₁
RIO BLANCO OIL SHALE PROJECT
HOLE GS-11
PRESSURE BOMB TEST
DEPTH - 996'
WRIGHT WATER ENGINEERS
AUGUST, 1974
DEPTH TO WATER (FEET)
520
530
540
550
560
570
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)

Fig.3


WATER VELOCITY AND TEMPERATURE
vs.
HOLE DEPTH
VELOCITY
TEMPERATURE
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
0 = Water Temperature (F°)
40°
50°
60°
70°
0
100
200
300
400
500
600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
DEPTH OF HOLE (feet)
RIO BLANCO
OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 11

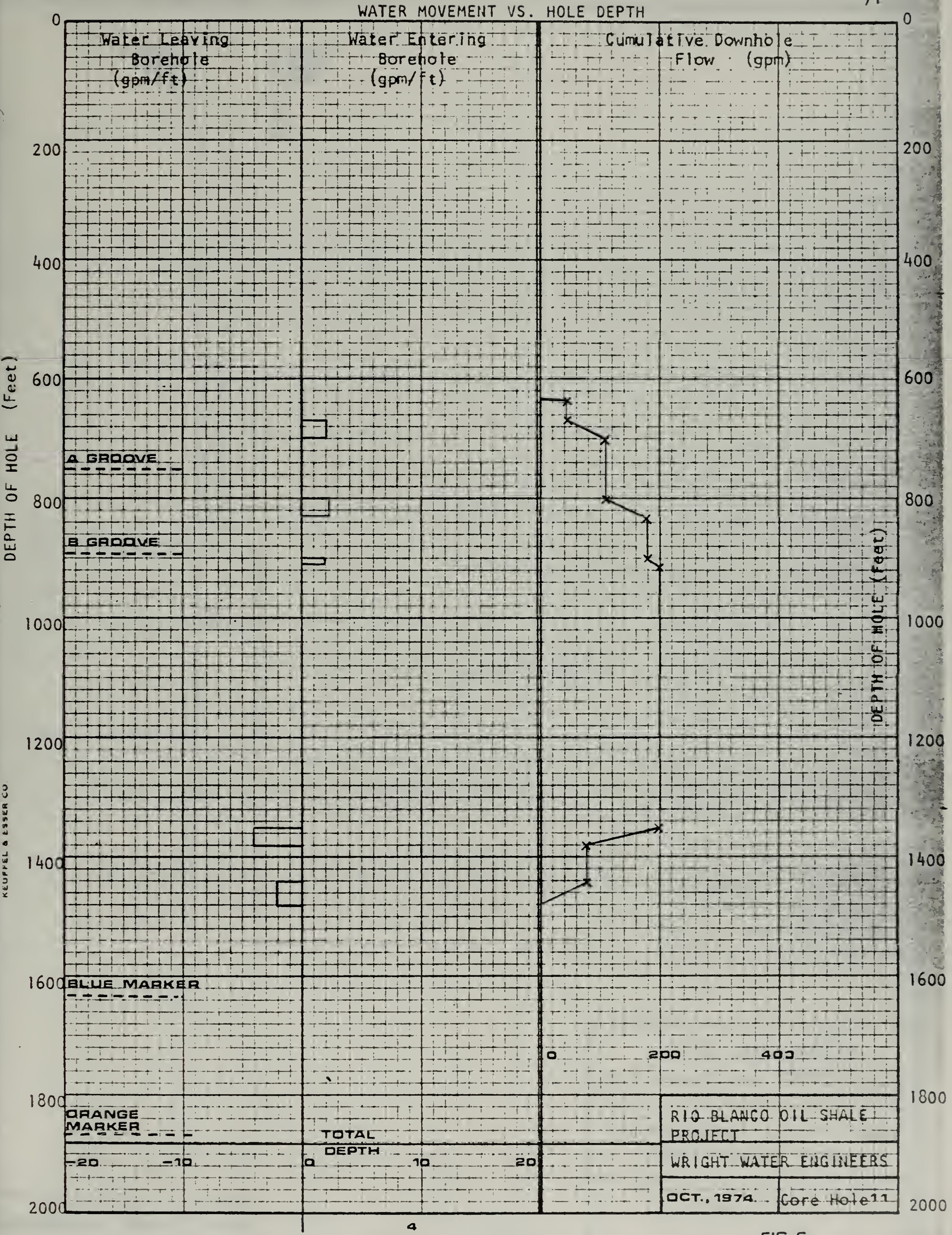
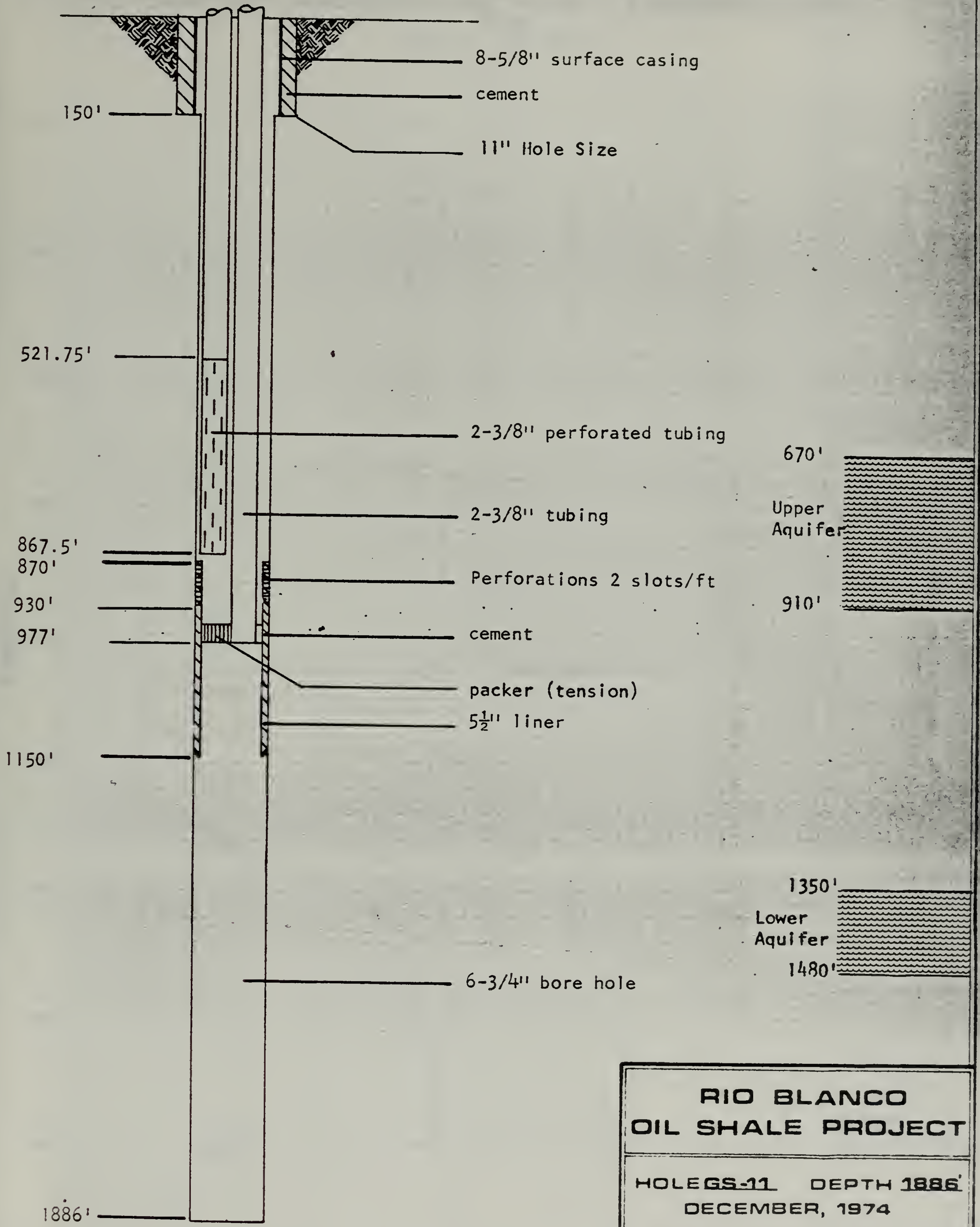

WATER MOVEMENT VS. HOLE DEPTH
Water Leaving Borehole (gpm/ft)
Water Entering Borehole (gpm/ft)
Cumulative Downhole Flow (gpm)
DEPTH OF HOLE (Feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
-20
-10
0
10
20
0
200
400
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 11

FIG. 6



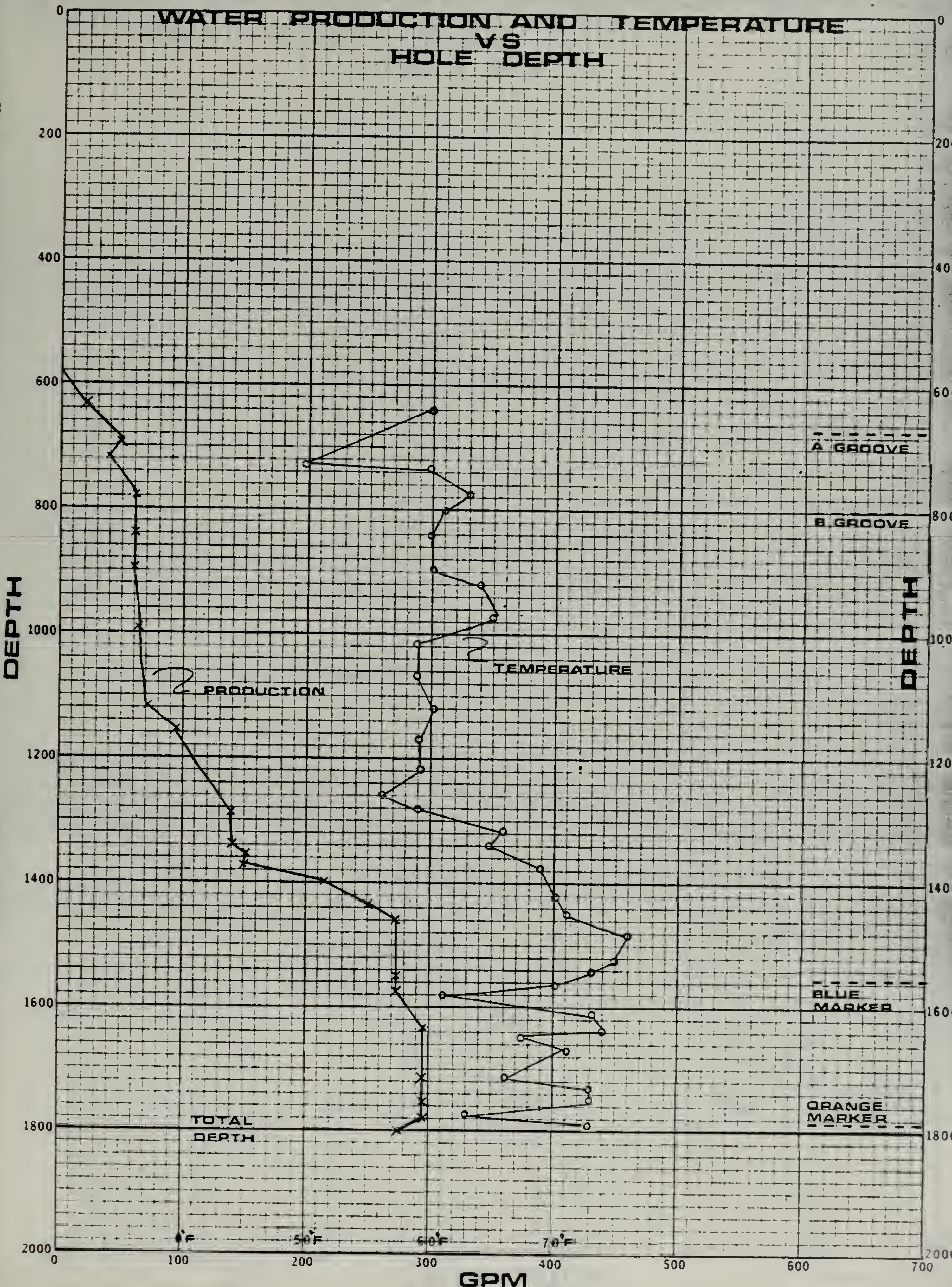
VERITICAL SCALE 1" - 200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

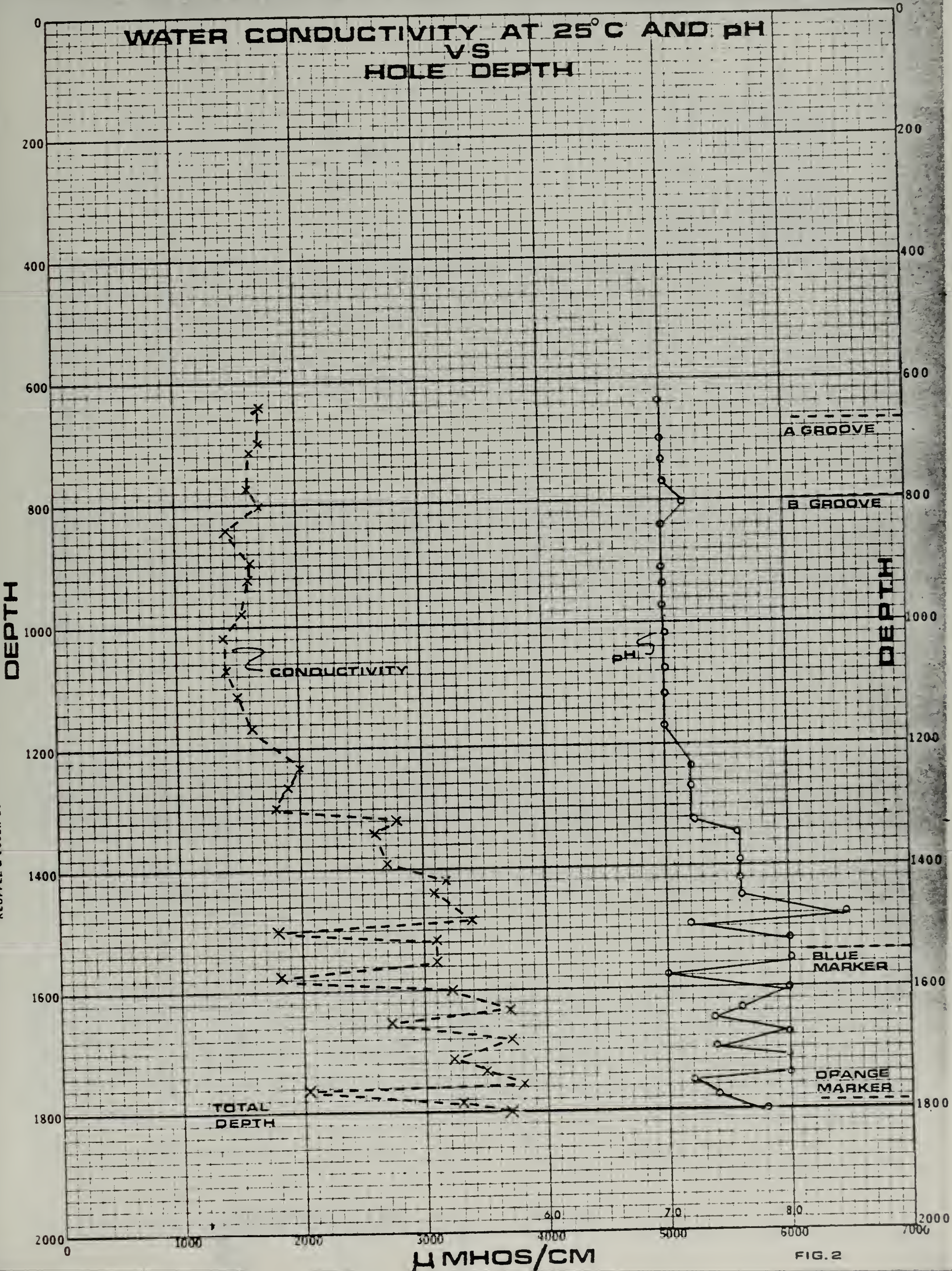
RIO BLANCO
OIL SHALE PROJECT

HOLE GS-11 DEPTH 1886'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211



K&E 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.
]



WATER CONDUCTIVITY AT 25°C AND pH VS HOLE DEPTH

FIG. 2

K•E 10 X 10 TO THE INCH 46 0703
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

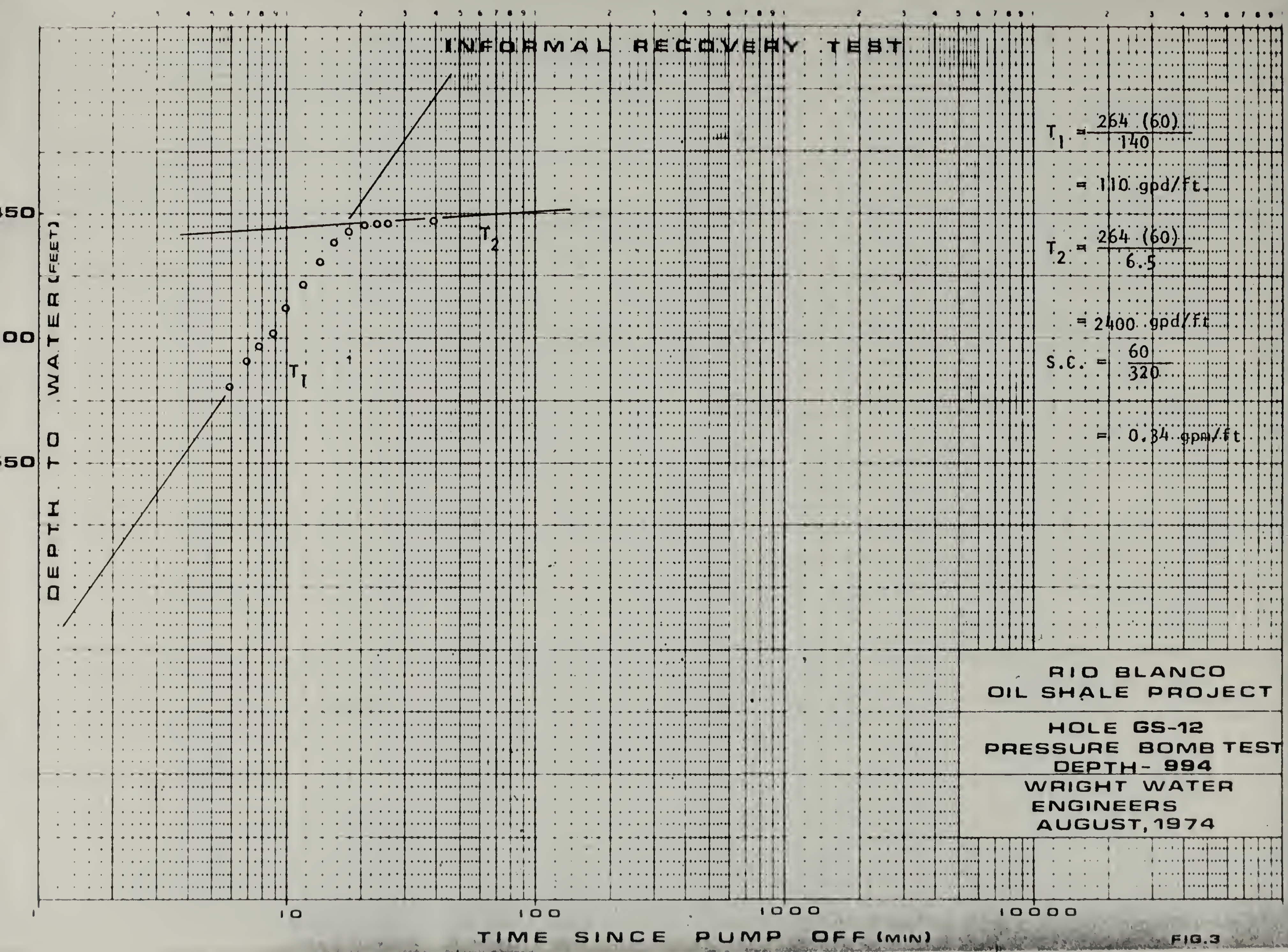

INFORMAL RECOVERY TEST
T1 = 264 (60) / 140
= 110 gpd/ft.
T2 = 264 (60) / 6.5
= 2400 gpd/ft
S.C. = 60 / 320
= 0.34 gpm/ft
T1
T2
50
00
50
DEPTH TO WATER (FEET)
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-12
PRESSURE BOMB TEST
DEPTH - 994
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.3

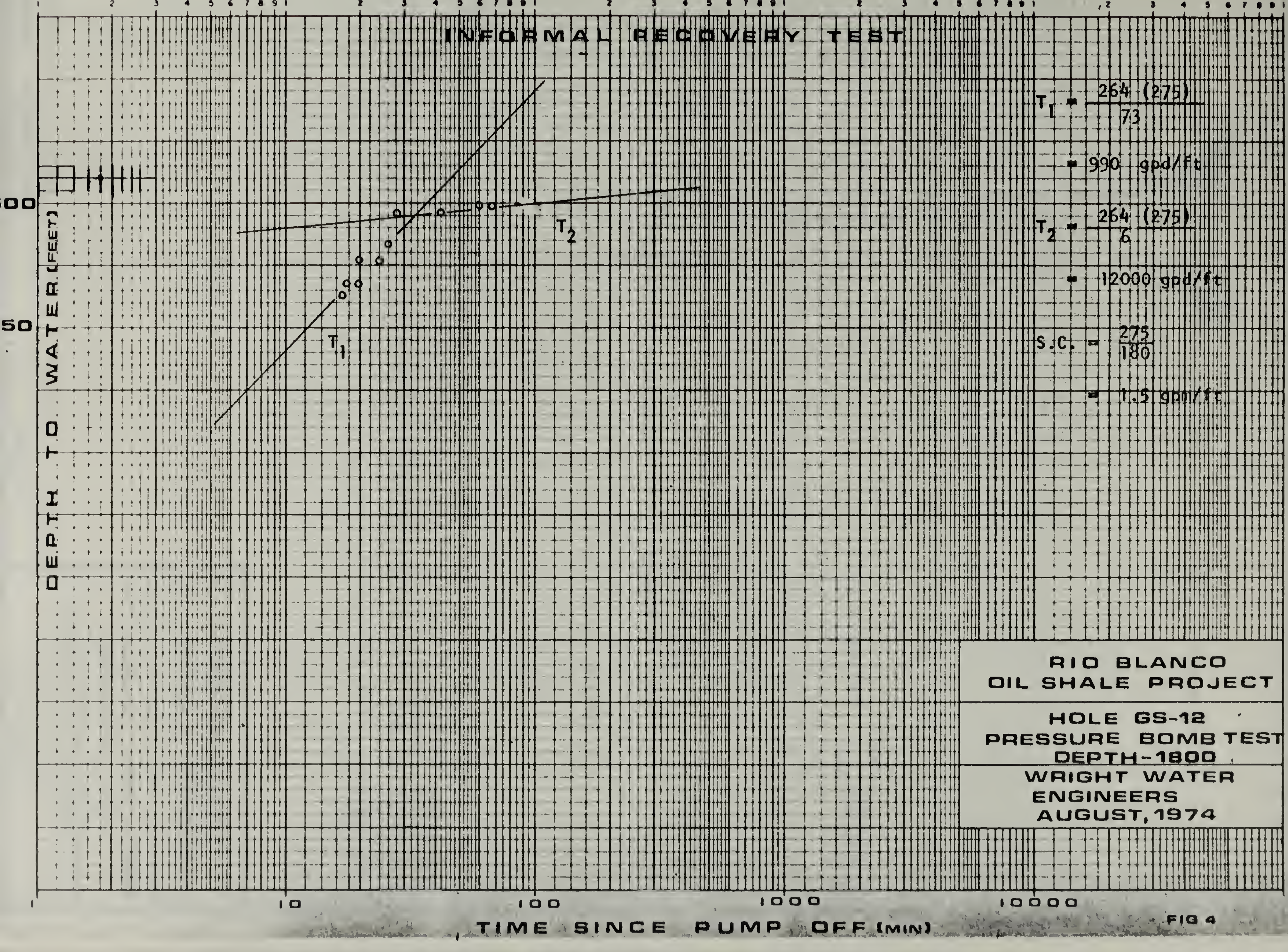
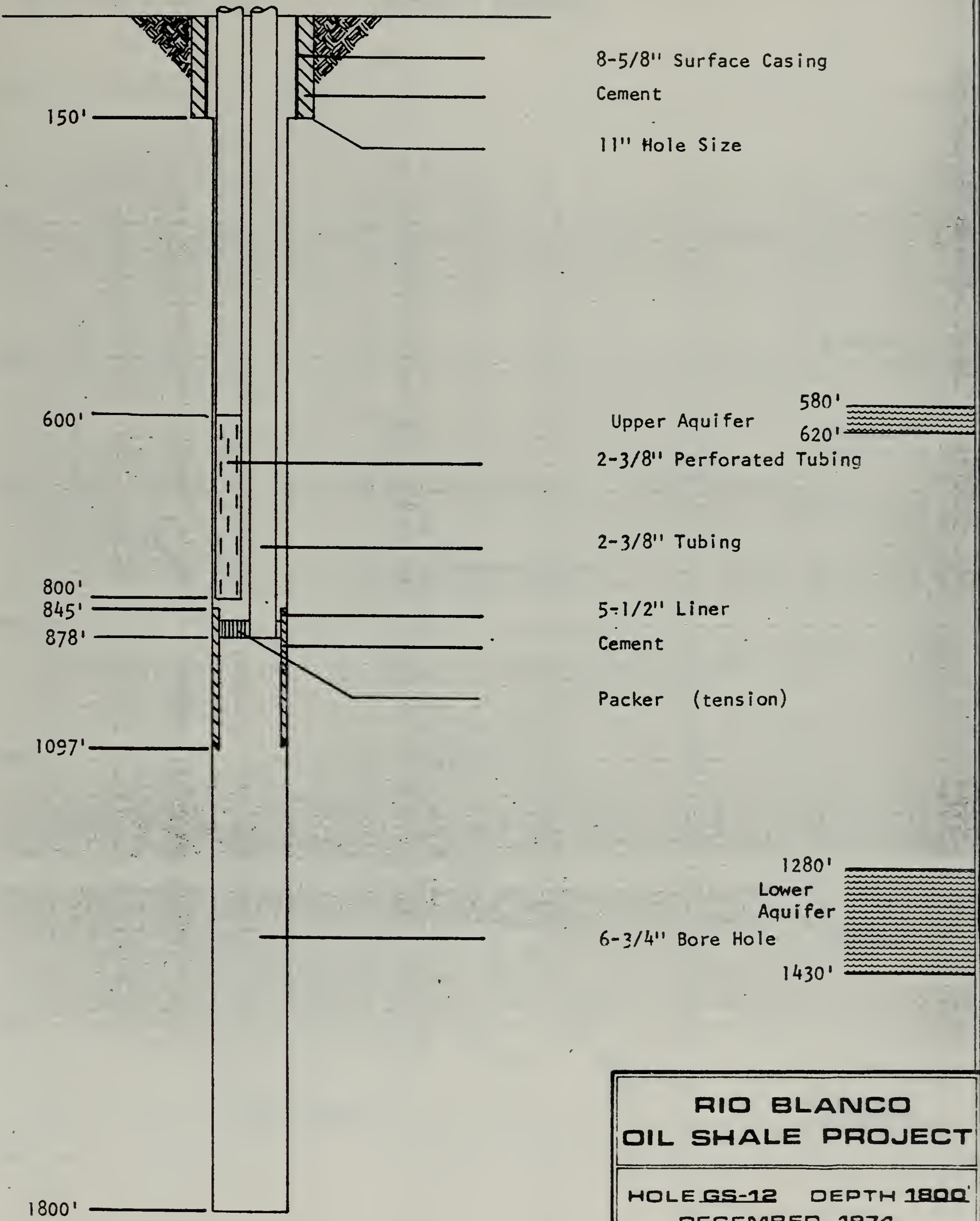

INFORMAL RECOVERY TEST
T1 = 264 (275) / 73
= 990 gpd/ft
T2 = 264 (275) / 6
= 12000 gpd/ft
S.C. = 275 / 180
= 1.5 gpm/ft
T1
T2
DEPTH TO WATER (FEET)
00
50
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-12
PRESSURE BOMB TEST
DEPTH-1800
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG 4



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-12 DEPTH 1800'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 8021?

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1-0"

FIG. 7

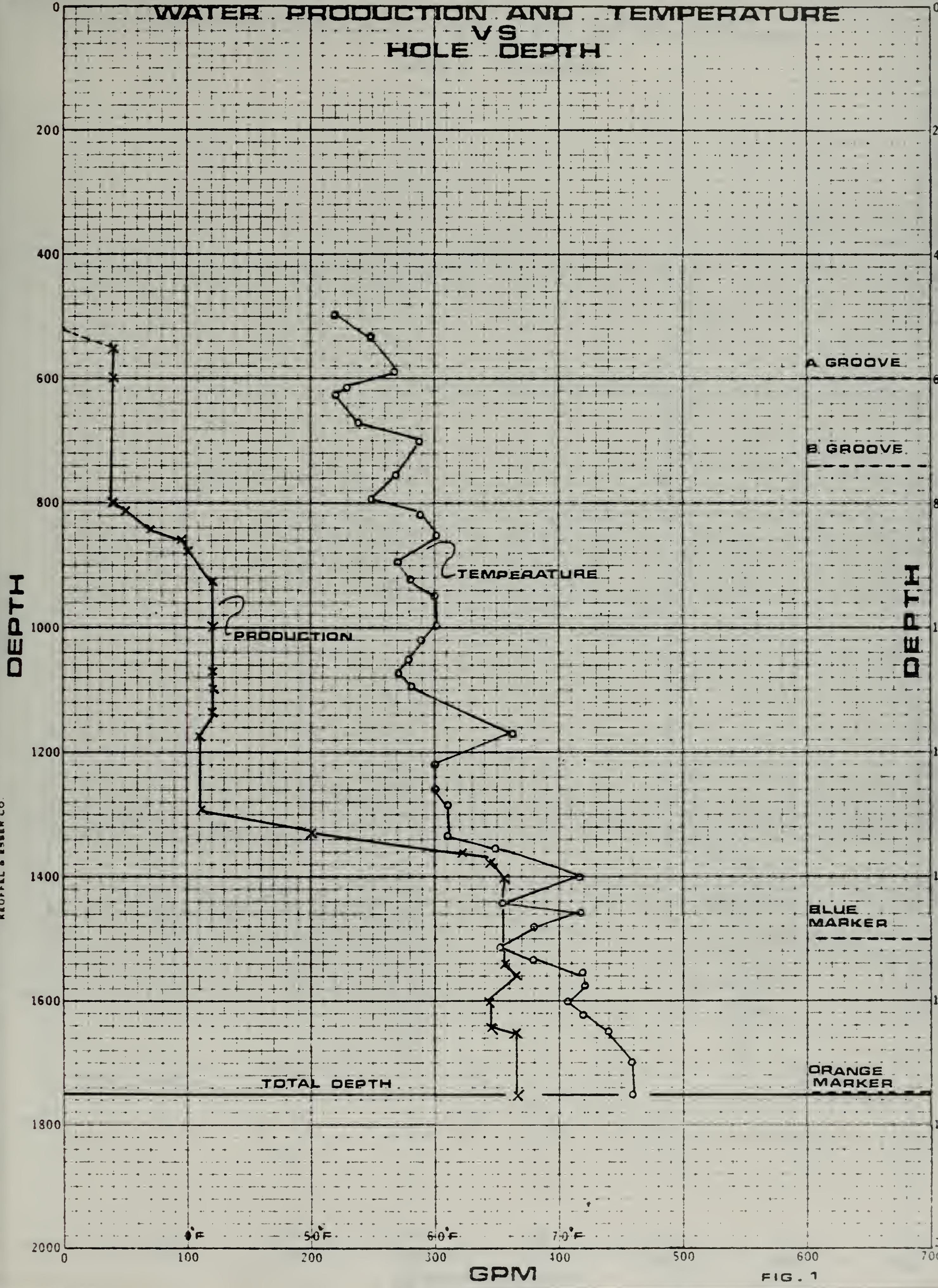

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
TEMPERATURE
PRODUCTION
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
40°F
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM

FIG. 1

GS-13

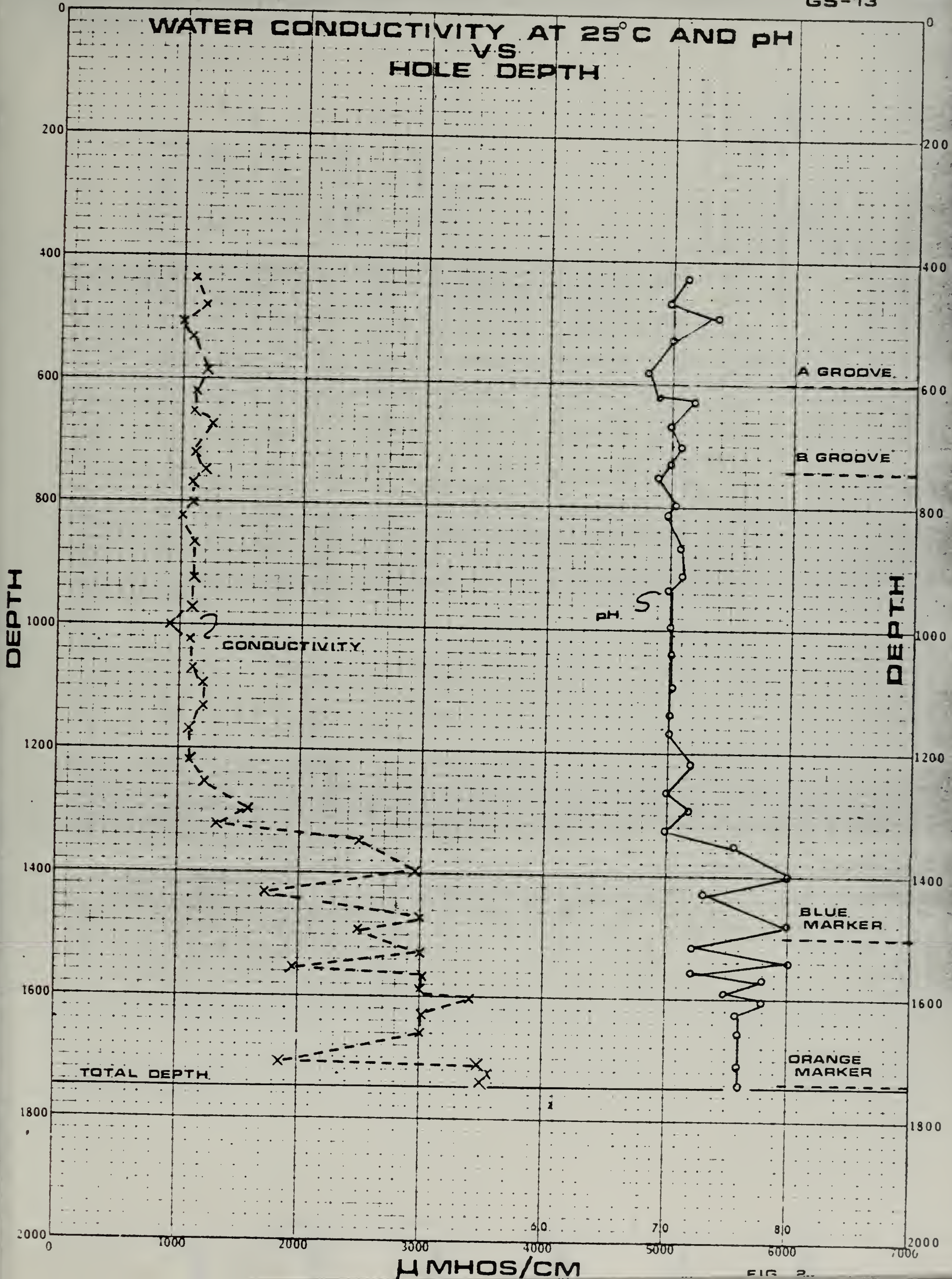
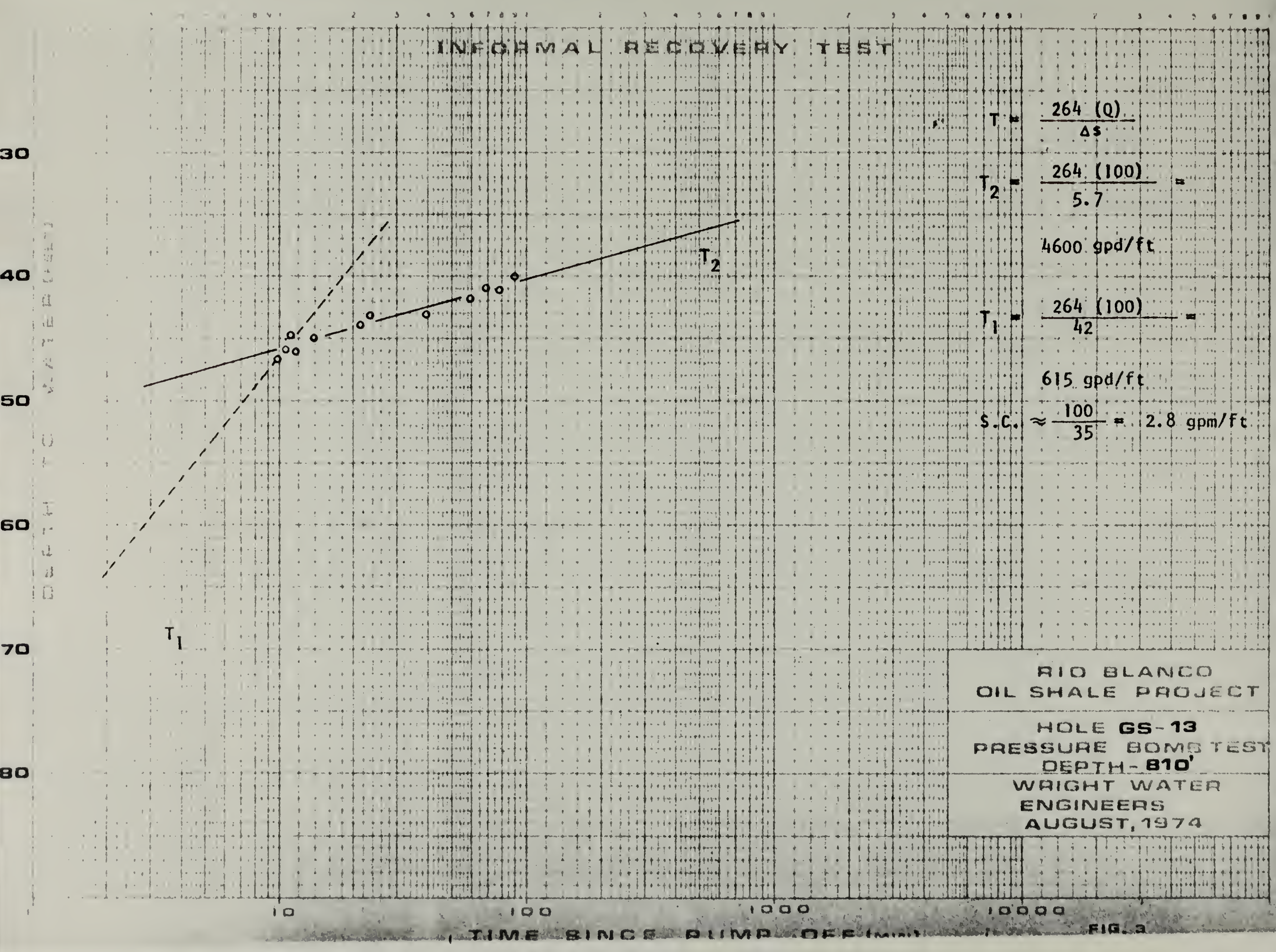

WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
CONDUCTIVITY
pH
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
6.0
7.0
8.0
0
1000
2000
3000
4000
5000
6000
7000
μ MHOS/CM

FIG. 2



$$T = \frac{264\ (Q)}{\Delta s}$$

$$T_2 = \frac{264\ (100)}{5.7} =$$

4600 gpd/ft

$$T_1 = \frac{264\ (100)}{42} =$$

615 gpd/ft

$$S.C. \approx \frac{100}{35} = 2.8 \text{ gpm/ft}$$

RIO BLANCO
OIL SHALE PROJECT

HOLE **GS-13**
PRESSURE BOMB TEST
DEPTH - **810'**

WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3

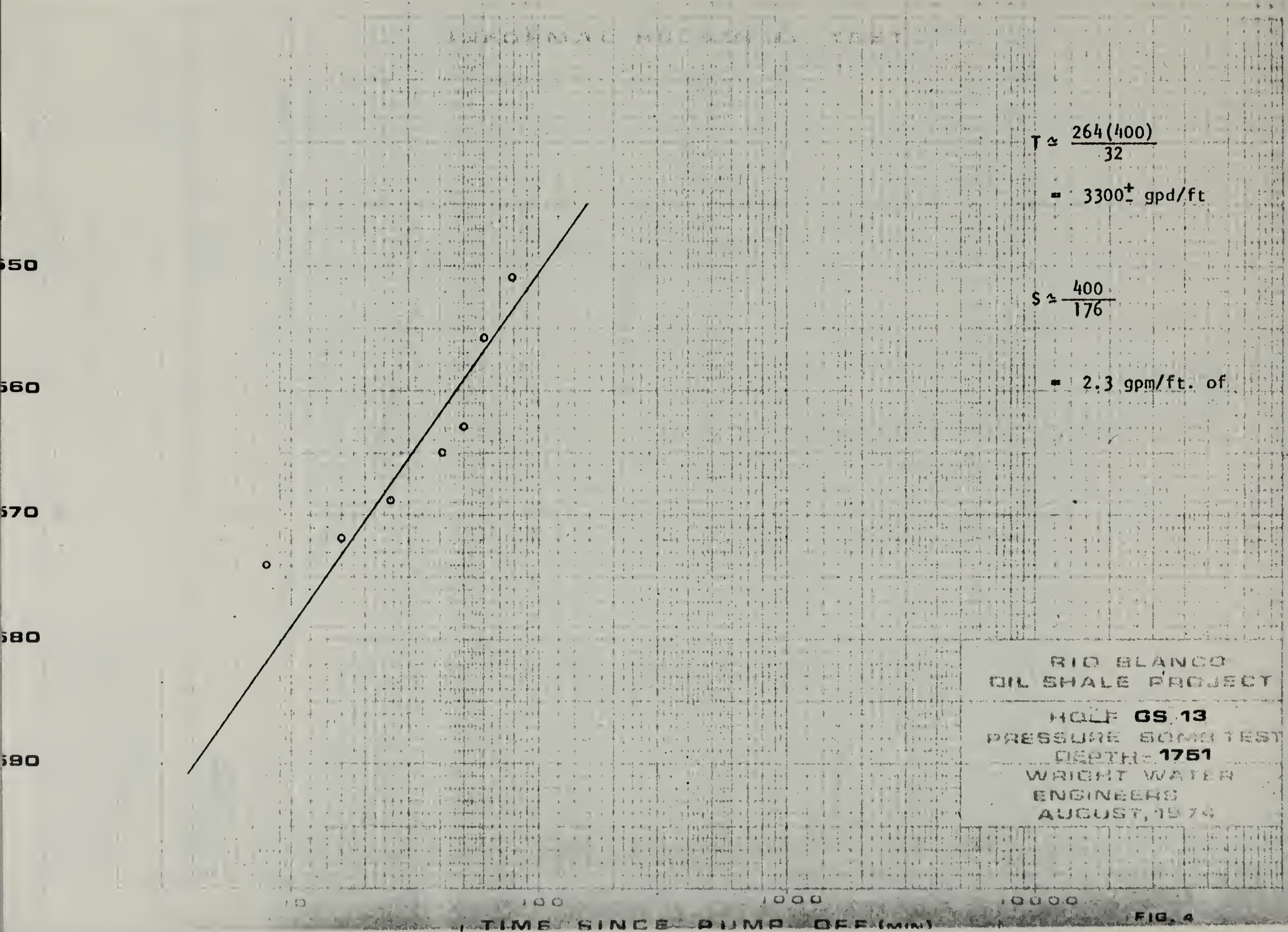
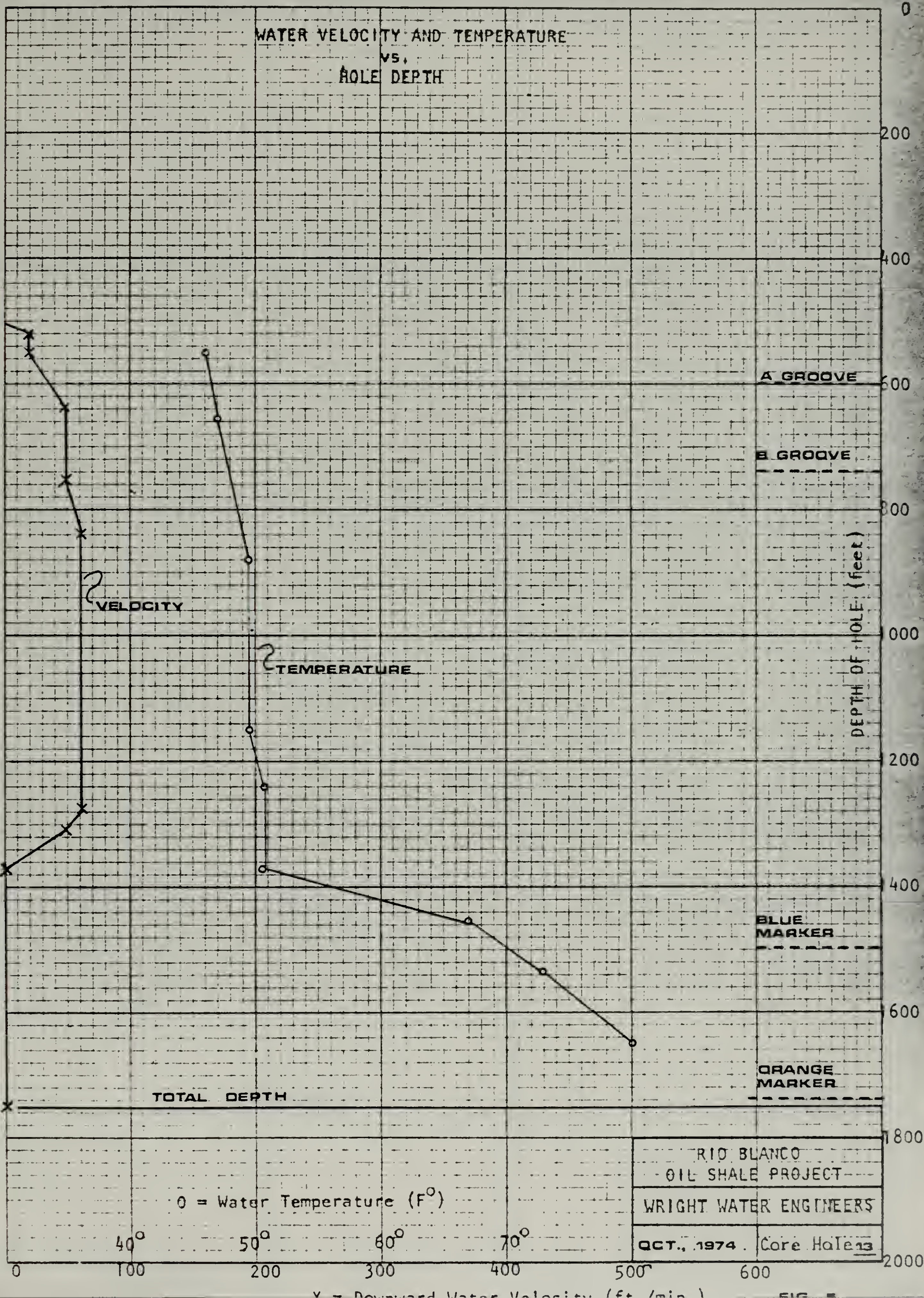

50
60
70
80
90
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
T ≈ 264(400)/32
= 3300± gpd/ft
S ≈ 400/176
= 2.3 gpm/ft. of
RIO BLANCO
OIL SHALE PROJECT
HOLE GS 13
PRESSURE BOMB TEST
DEPTH- 1751
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 4

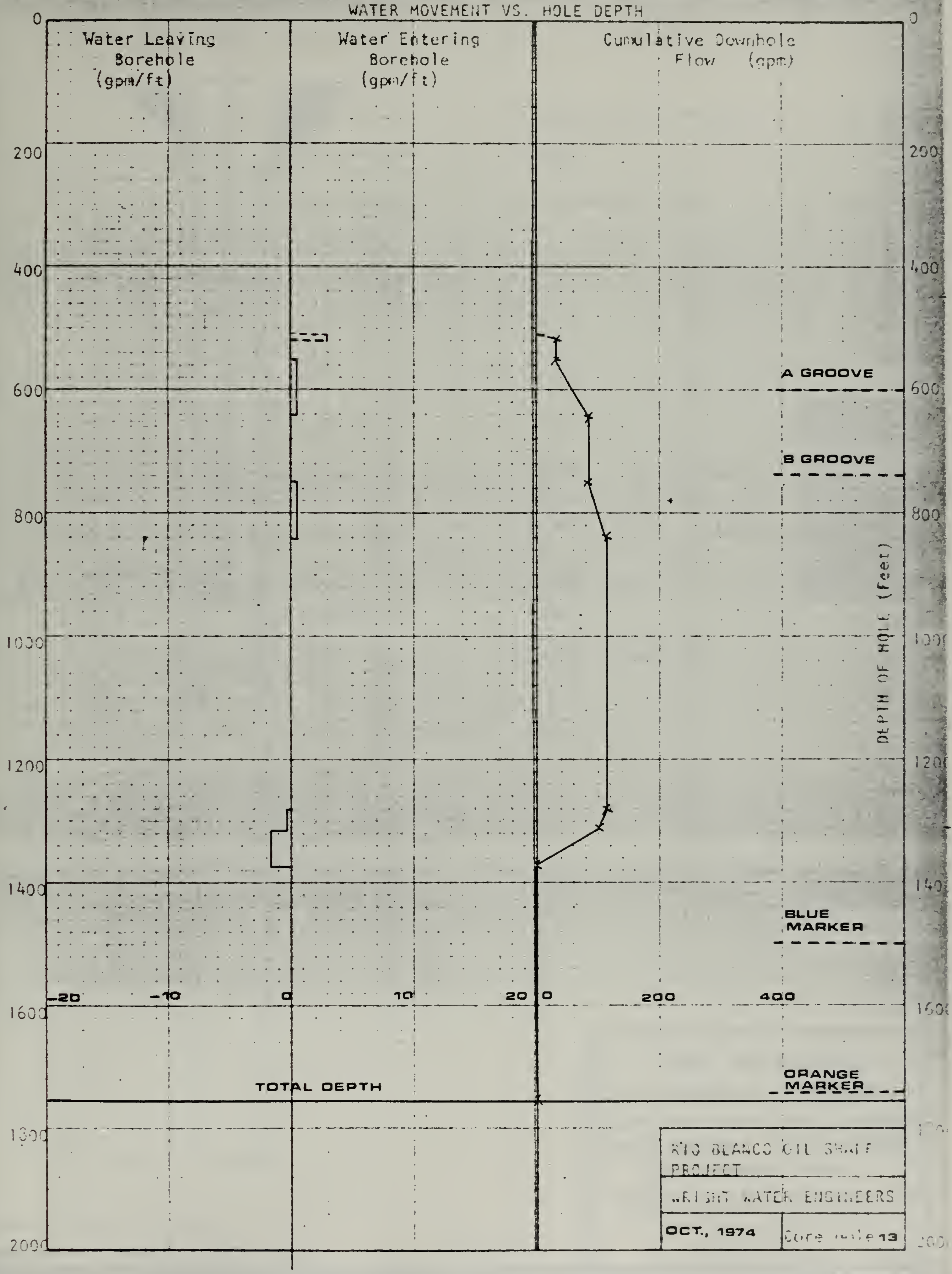


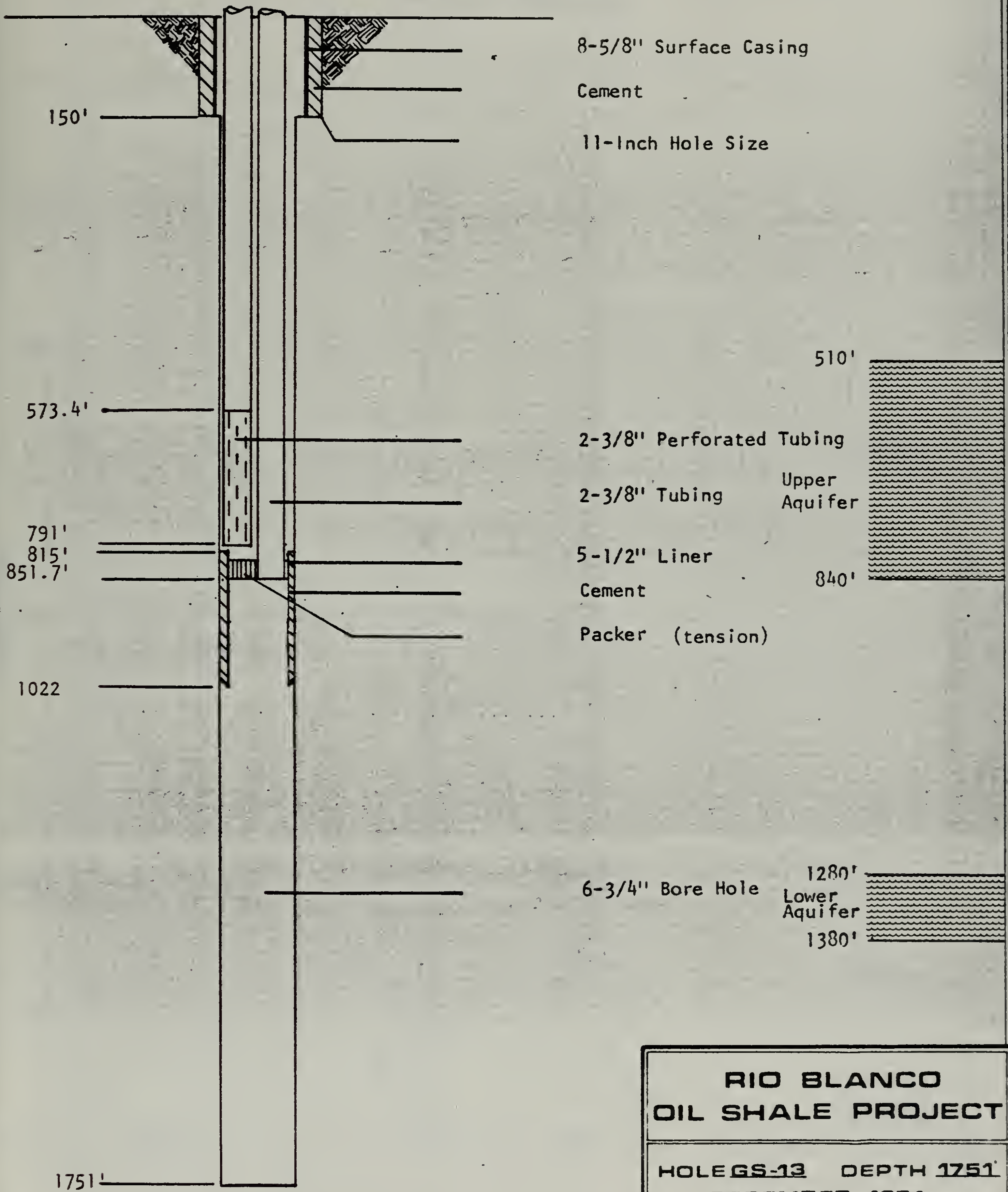
WATER VELOCITY AND TEMPERATURE
vs.
HOLE DEPTH

RIO BLANCO
OIL SHALE PROJECT

WRIGHT WATER ENGINEERS

OCT., 1974 . Core Hole 13


WATER MOVEMENT VS. HOLE DEPTH
Water Leaving Borehole (gpm/ft)
Water Entering Borehole (gpm/ft)
Cumulative Downhole Flow (gpm)
DEPTH OF HOLE (Feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
-20
-10
0
10
20
0
200
400
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 13



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-13 DEPTH 1751'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"- 200'
HORIZONTAL SCALE 1"-1' 0"

FIG. 7

GS-14

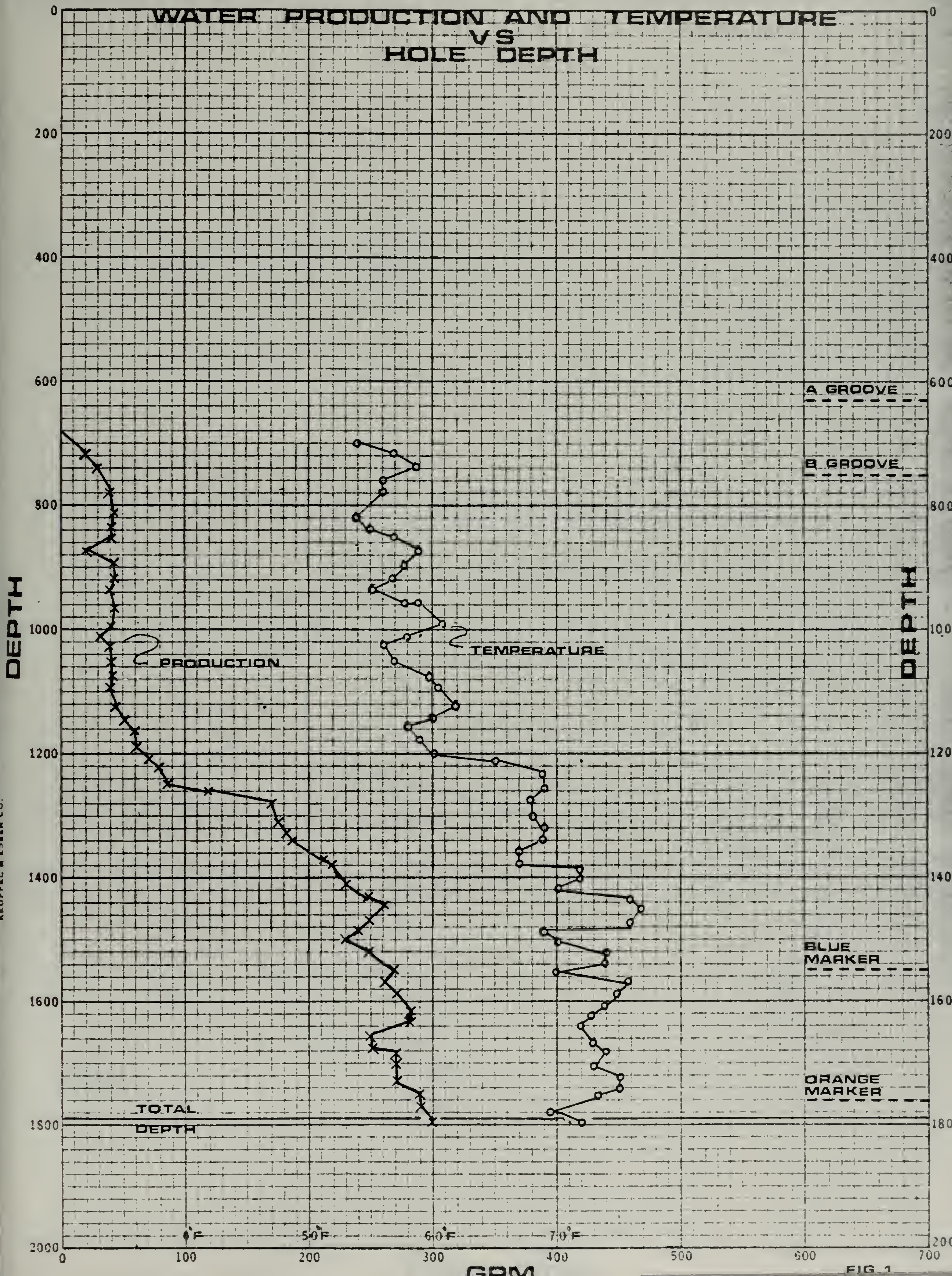

WATER PRODUCTION AND TEMPERATURE VS HOLE DEPTH

FIG. 1

GS-14

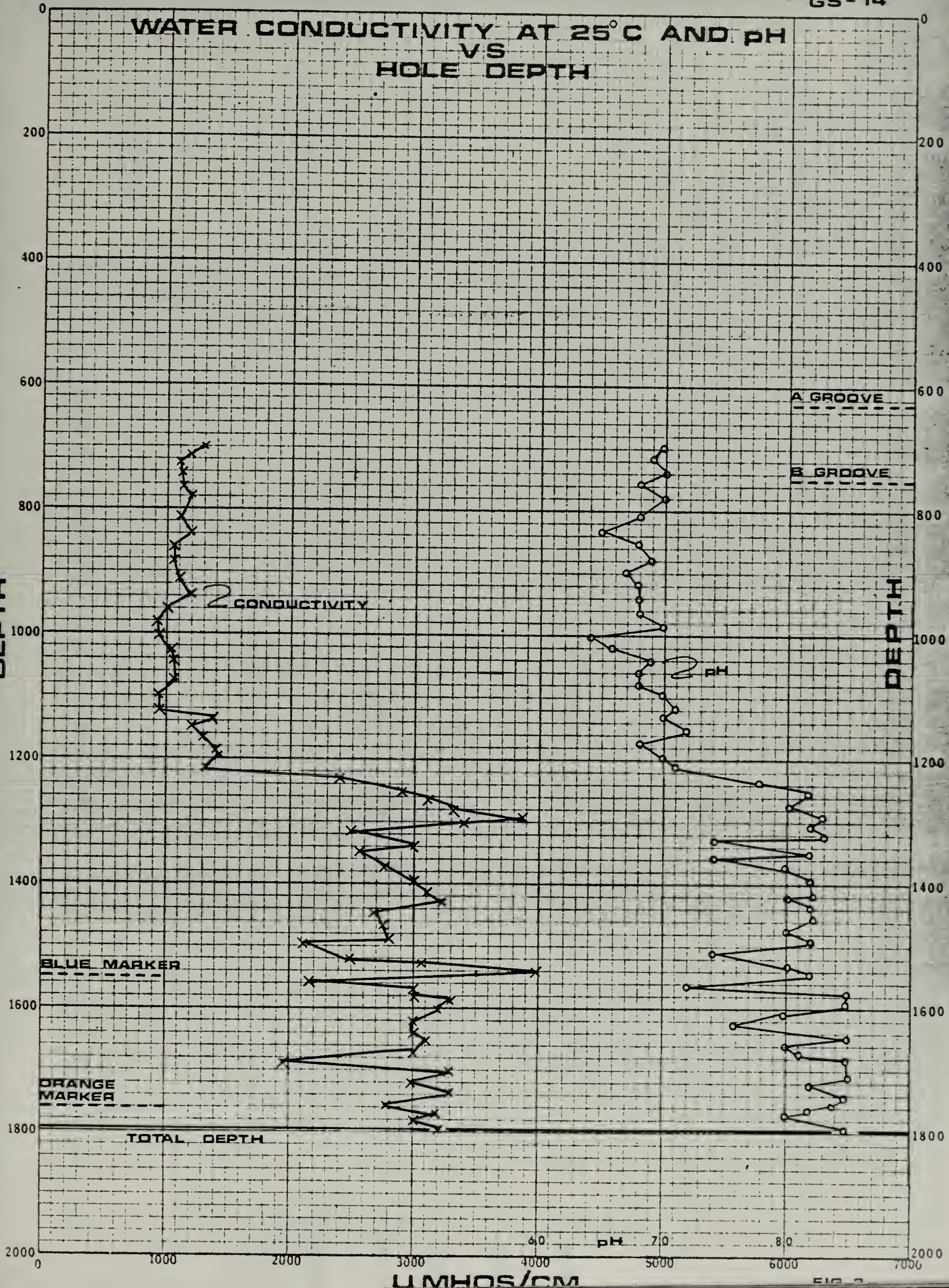
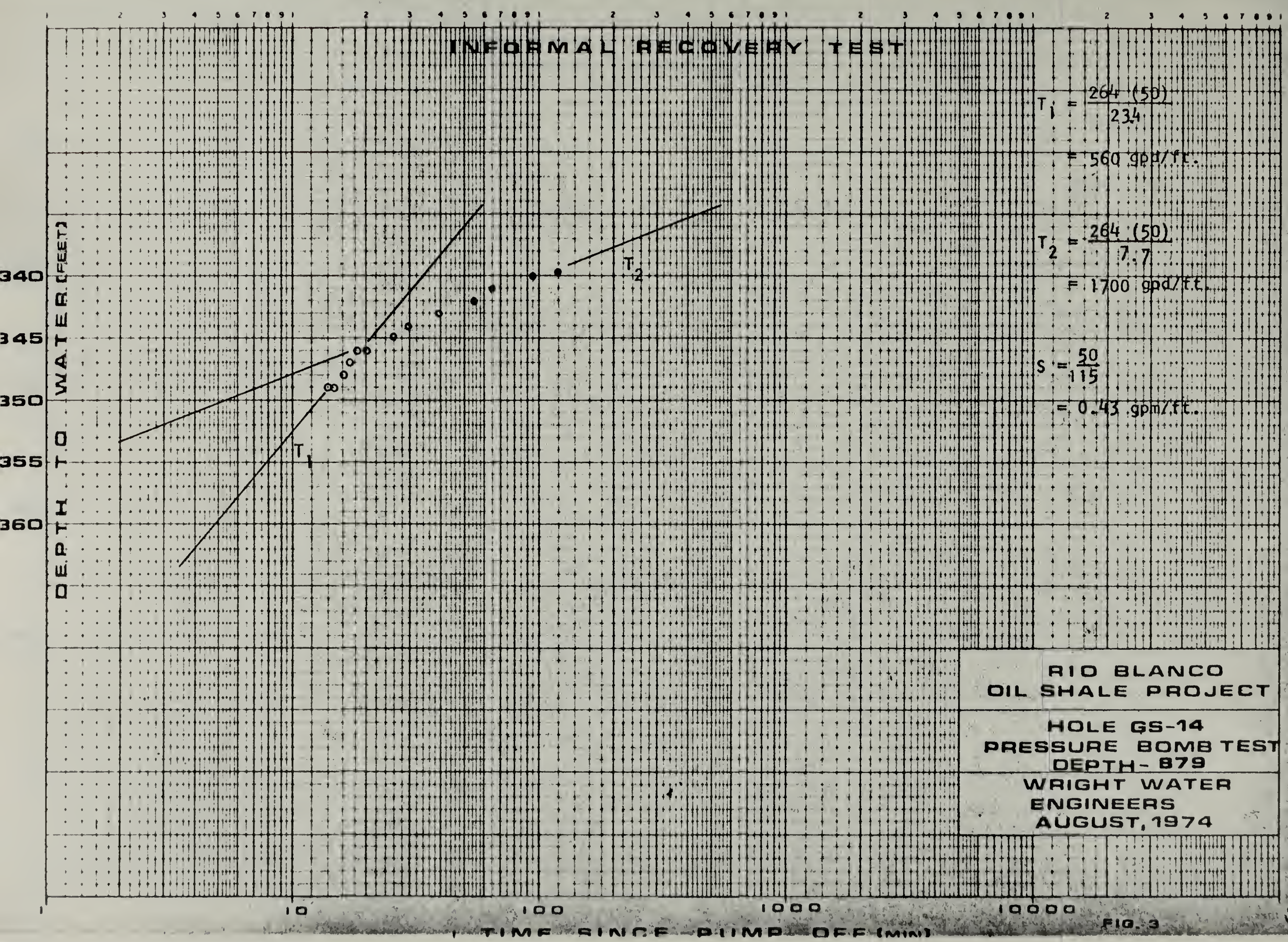

WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
2 CONDUCTIVITY
2 pH
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
0
1000
2000
3000
4000
5000
6000
7000
6.0
pH
7.0
8.0
μ MHOS/CM
KEUFFEL & ESSER CO.

FIG.



$T_1 = \frac{264\ (50)}{234}$

$= 560$ gpd/ft.

$T_2 = \frac{264\ (50)}{7.7}$

$= 1700$ gpd/ft.

$S = \frac{50}{115}$

$= 0.43$ gpm/ft.

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-14
PRESSURE BOMB TEST
DEPTH - 879

WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3

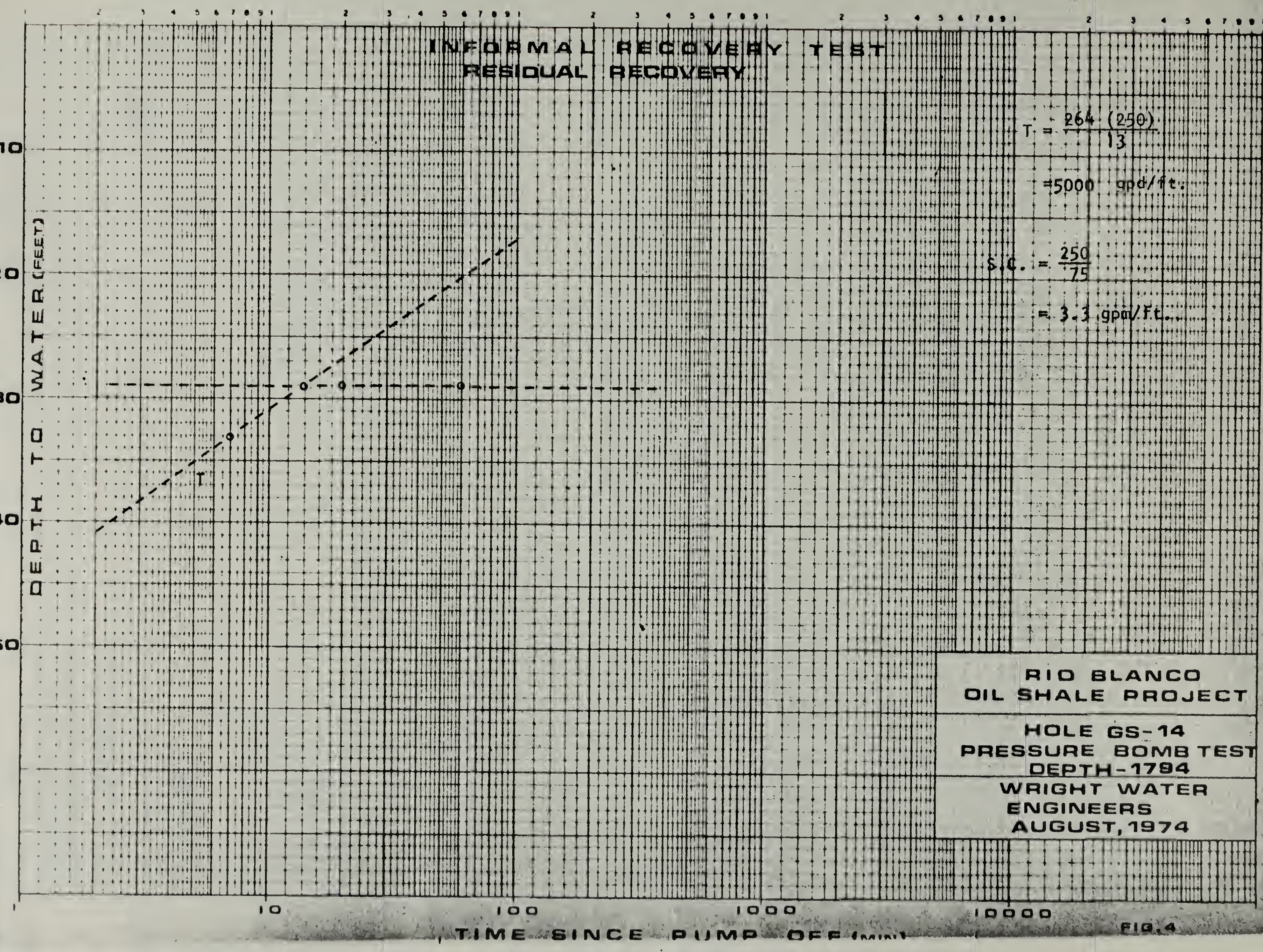

INFORMAL RECOVERY TEST
RESIDUAL RECOVERY
T = 264 (250) / 13
=5000 gpd/ft.
S.C. = 250 / 75
= 3.3 gpm/ft.
T
DEPTH TO WATER (FEET)
10
20
30
40
50
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-14
PRESSURE BOMB TEST
DEPTH-1794
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.4

WATER VELOCITY AND TEMPERATURE VS HOLE DEPTH

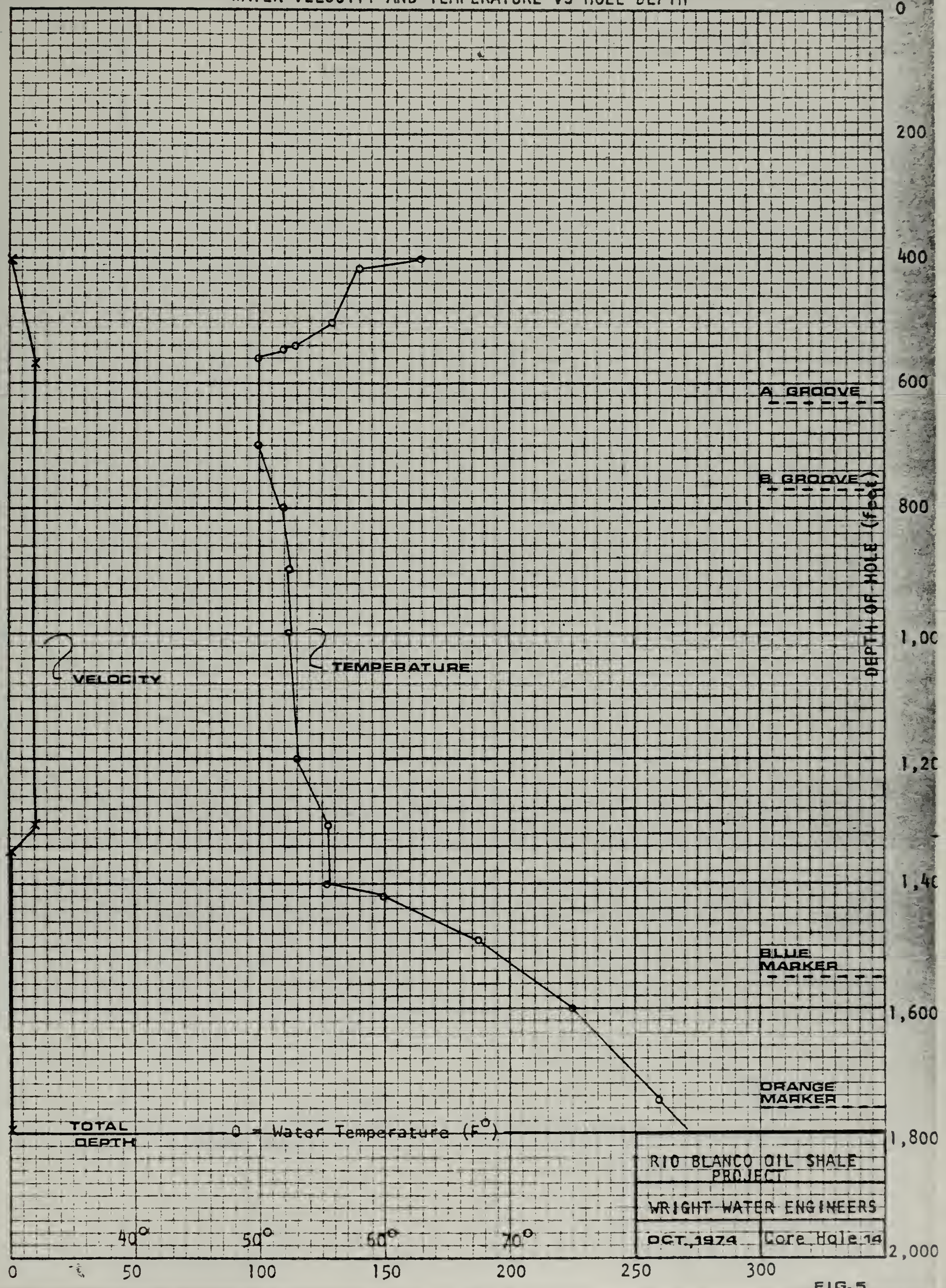


FIG. 5

KEUFFEL & ESSER CO.

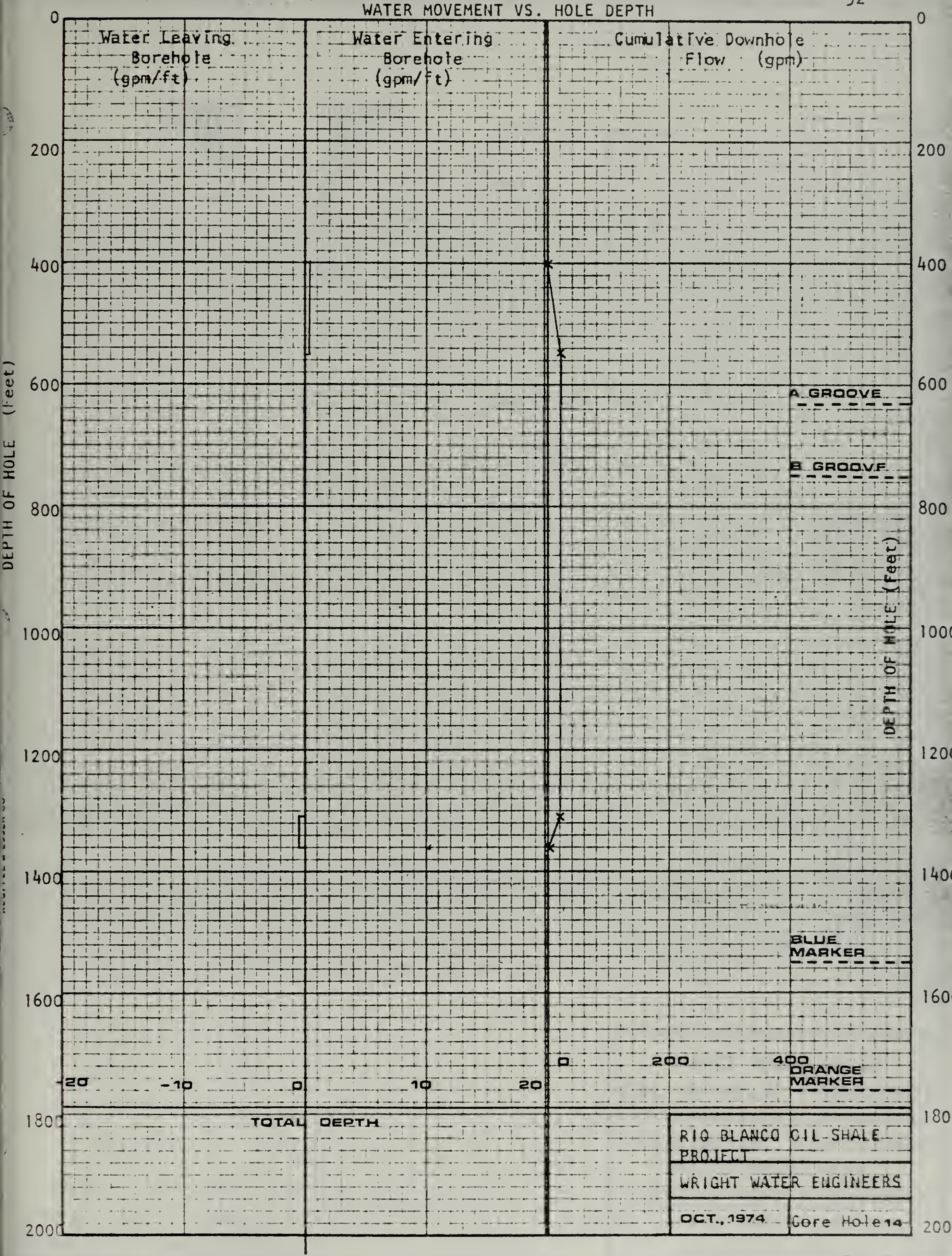
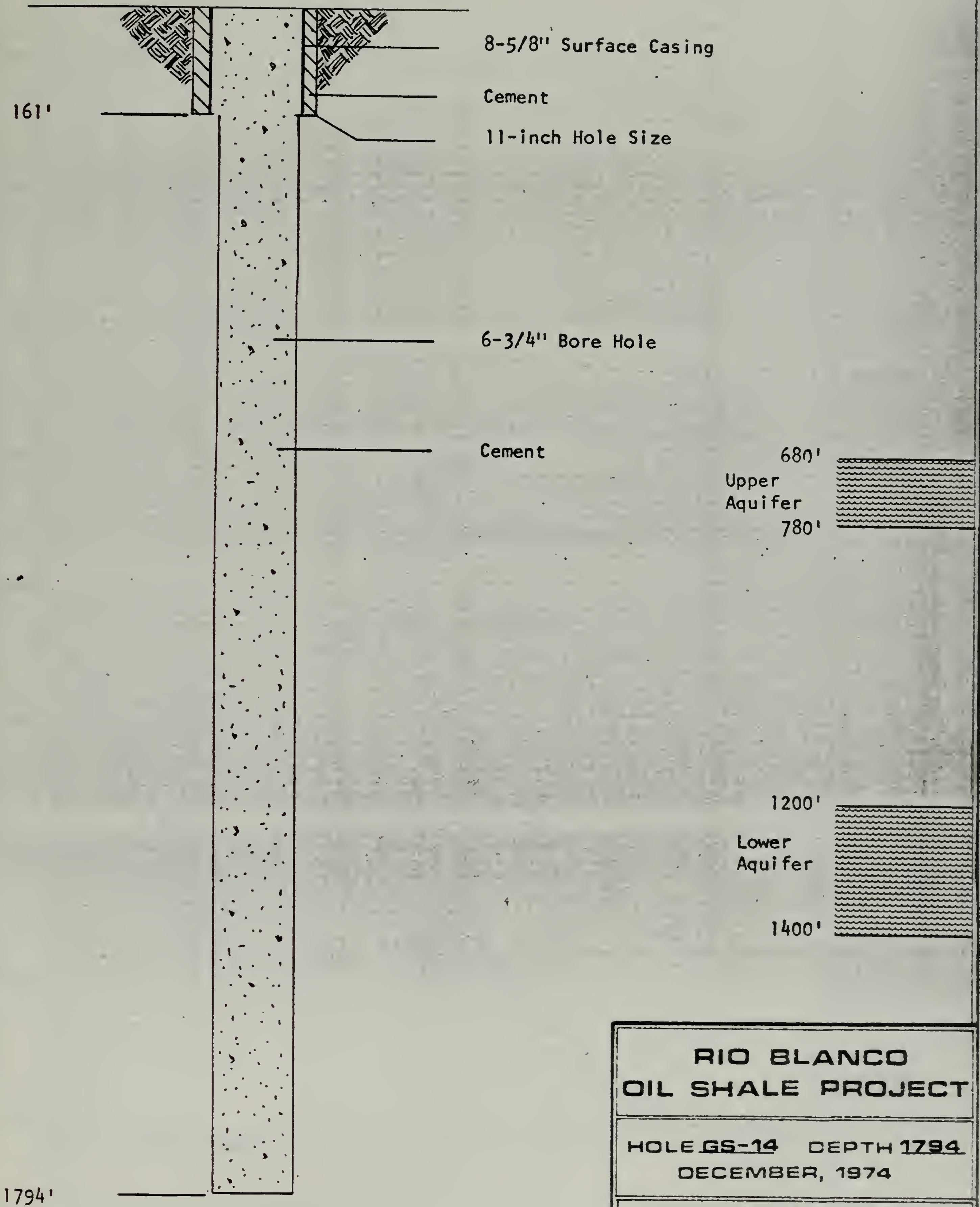

WATER MOVEMENT VS. HOLE DEPTH
Water Leaving Borehole (gpm/ft)
Water Entering Borehole (gpm/ft)
Cumulative Downhole Flow (gpm)
DEPTH OF HOLE (Feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
-20
-10
0
10
20
0
200
400
TOTAL DEPTH
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Core Hole 14

FIG. 6



ERITICAL SCALE 1"-200'

ORIZONTAL SCALE 1"-1'-0"

FIG. 7

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-14 DEPTH 1794
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
8420 ALCOTT STREET
DENVER COLORADO 80211

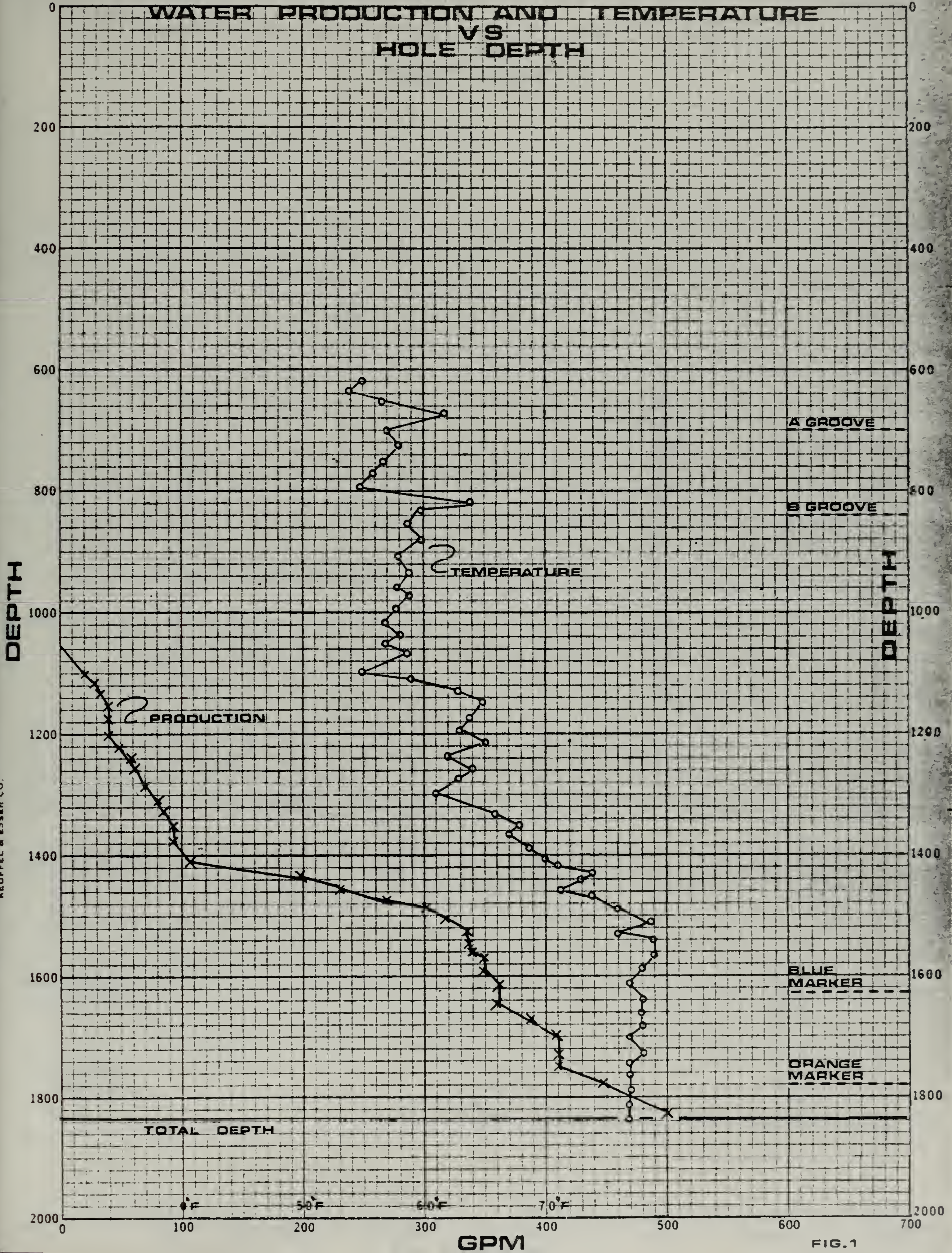
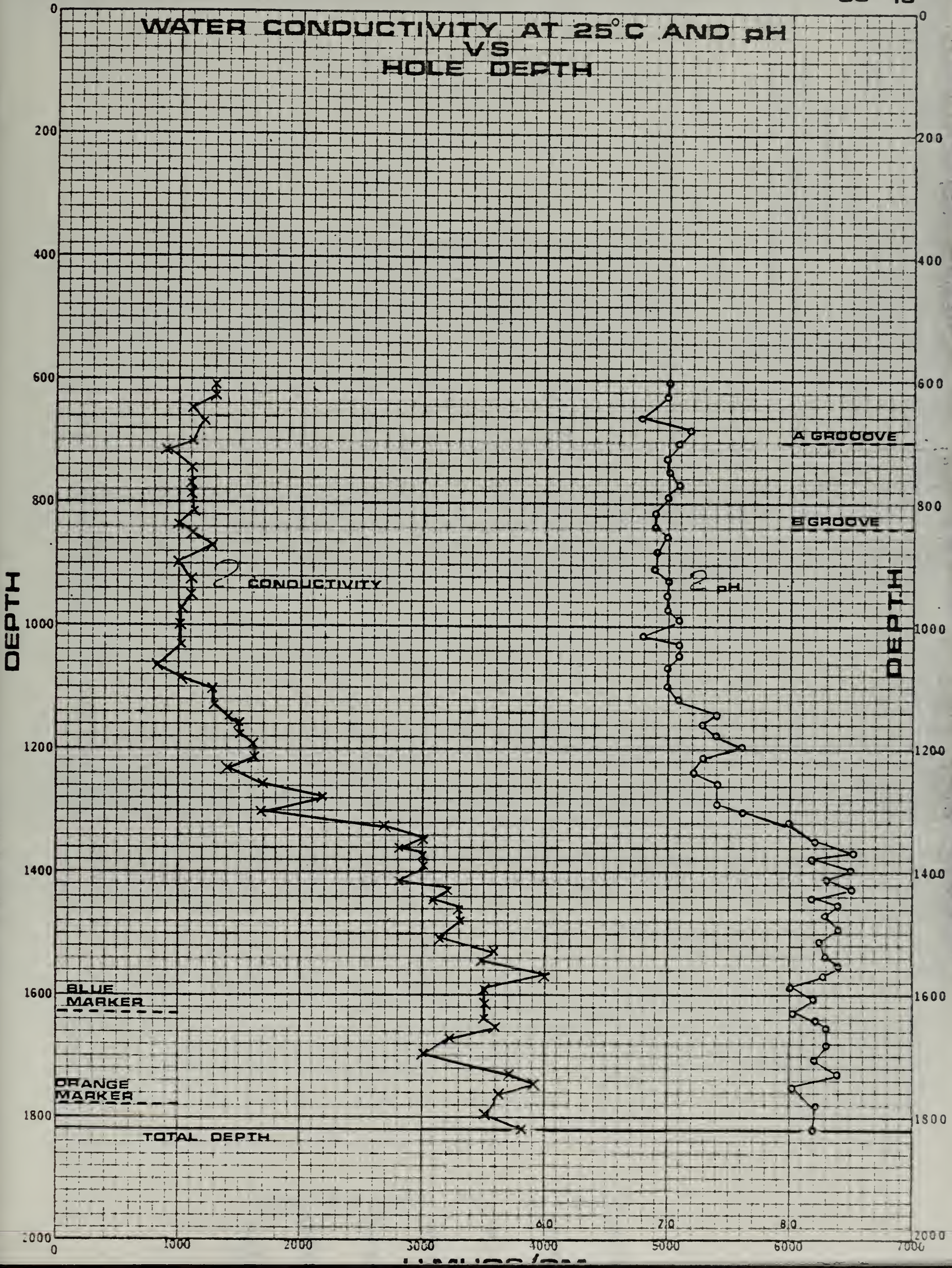

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
TEMPERATURE
PRODUCTION
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
°F
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM

FIG.1

GS- 15


WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2 CONDUCTIVITY
2 pH
A GROOOVE
B GROOVE
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
0
1000
2000
3000
4000
5000
6000
7000
6.0
7.0
8.0
KEUFFEL & ESSER CO.

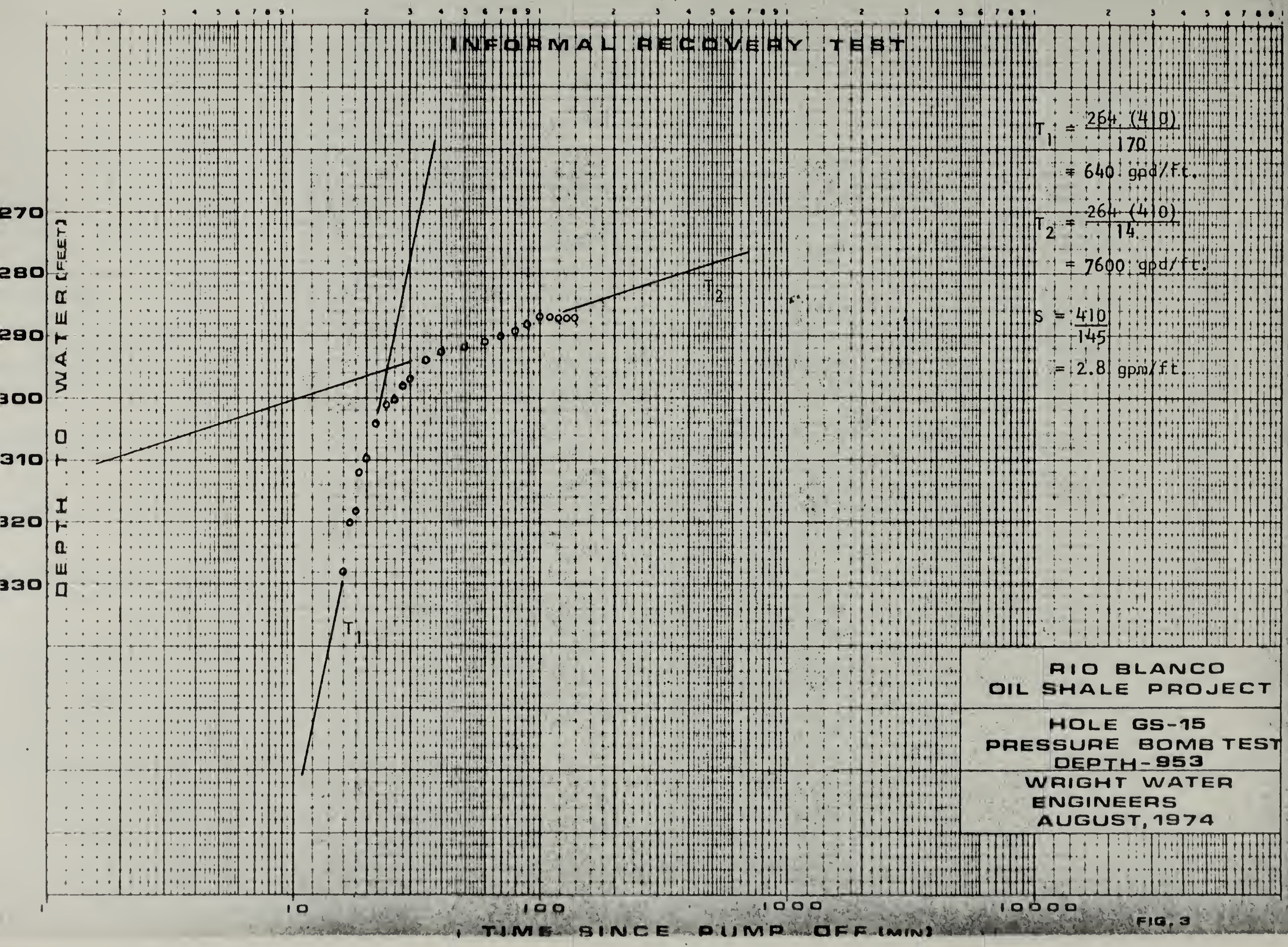
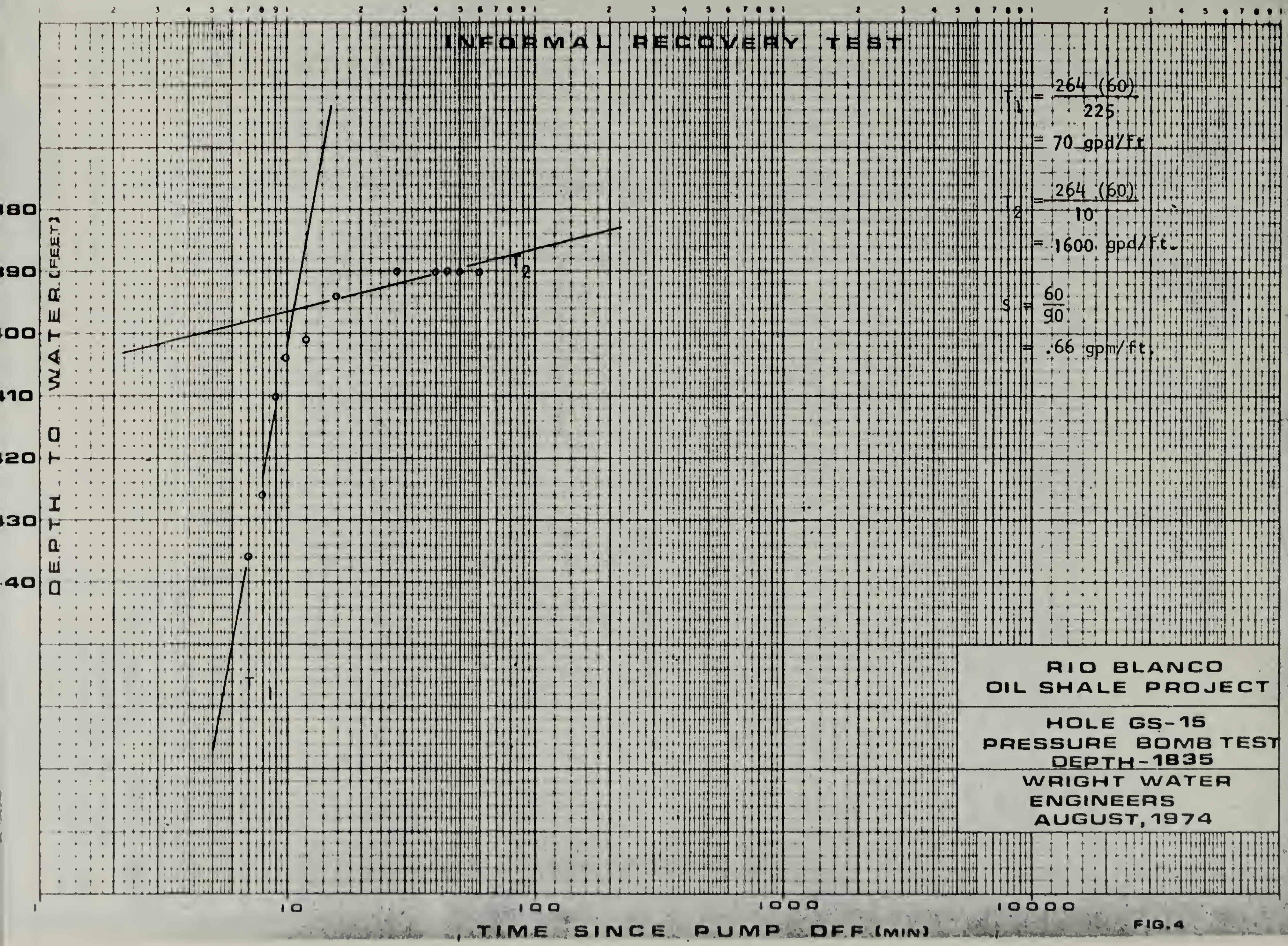

INFORMAL RECOVERY TEST
$T_1 = \frac{264\ (410)}{170}$
= 640 gpd/ft.
$T_2 = \frac{264\ (410)}{14}$
= 7600 gpd/ft.
$S = \frac{410}{145}$
= 2.8 gpm/ft.
T_1
T_2
DEPTH TO WATER (FEET)
270
280
290
300
310
320
330
TIME SINCE PUMP OFF (MIN)
1
10
100
1000
10000
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-15
PRESSURE BOMB TEST
DEPTH-953
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3



$T_1 = \frac{264\ (60)}{225}$

$= 70$ gpd/ft

$T_2 = \frac{264\ (60)}{10}$

$= 1600$ gpd/ft.

$S = \frac{60}{90}$

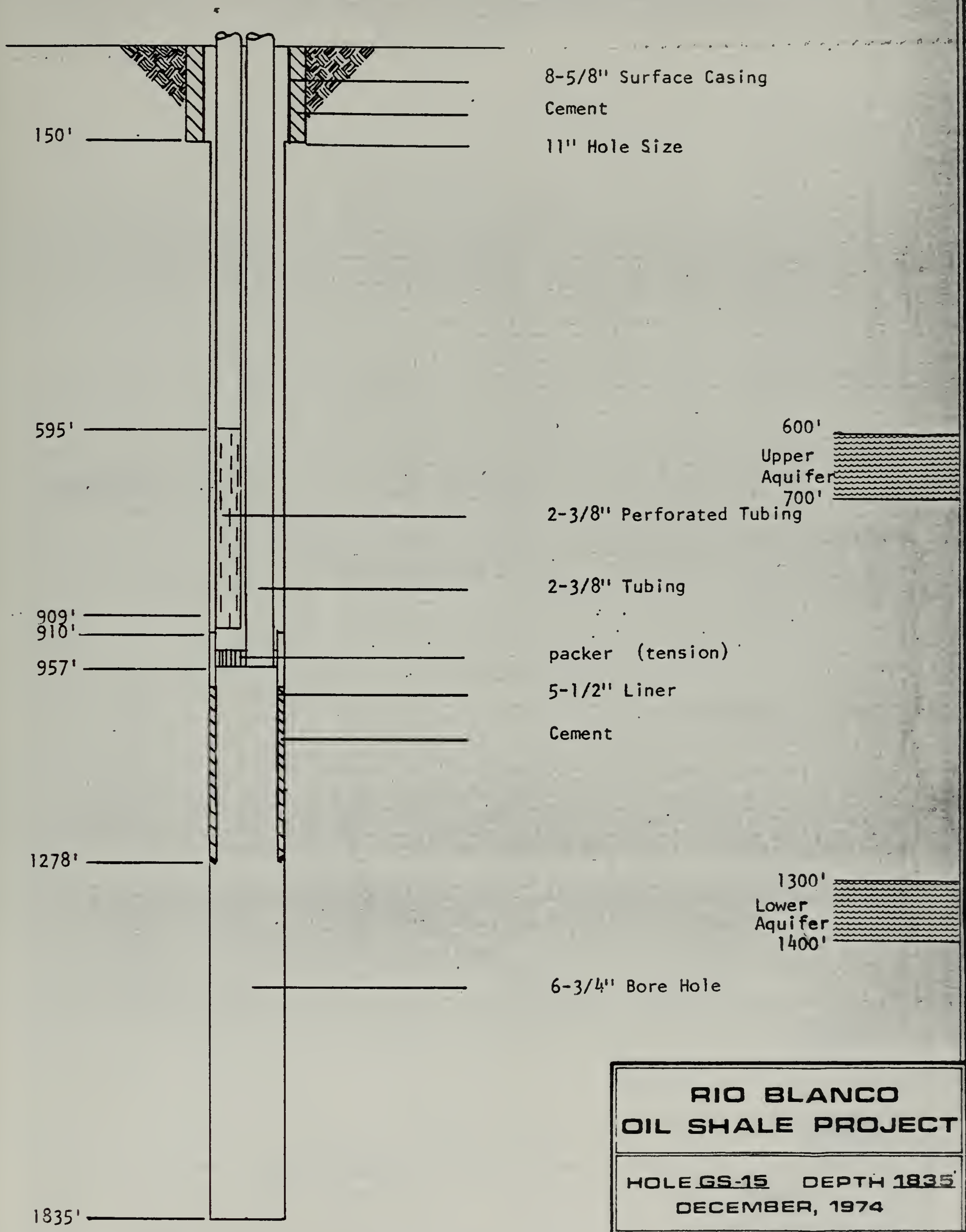
$= .66$ gpm/ft.

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-15
PRESSURE BOMB TEST
DEPTH-1835

WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.4



VERITICAL SCALE 1"-200'

HORIZONTAL SCALE 1"-1'-0"

FIG. 7

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-15 DEPTH 1835'
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

WATER VELOCITY AND TEMPERATURE VS HOLE DEPTH

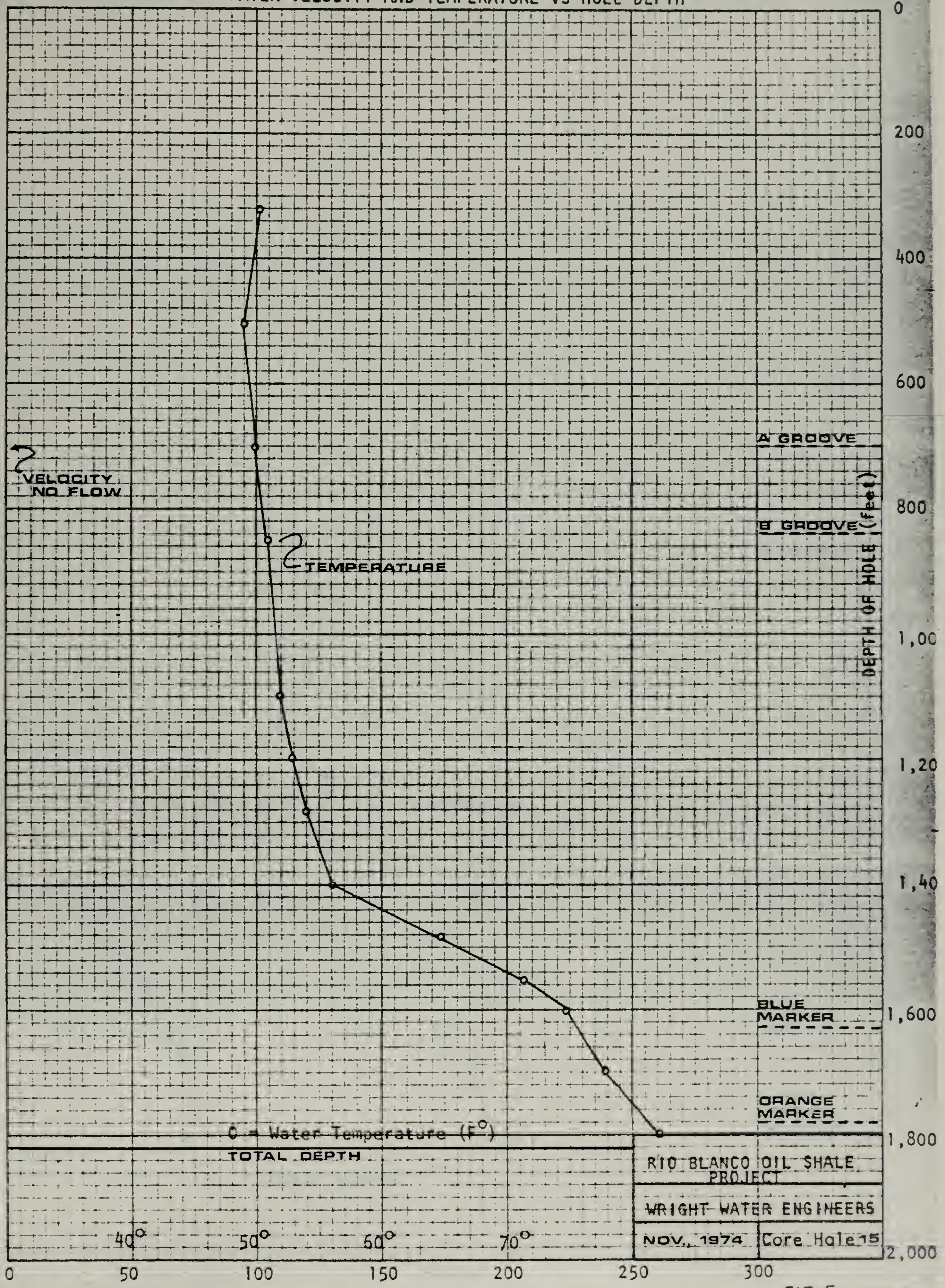


FIG 5

KEUFFEL & ESSER CO.

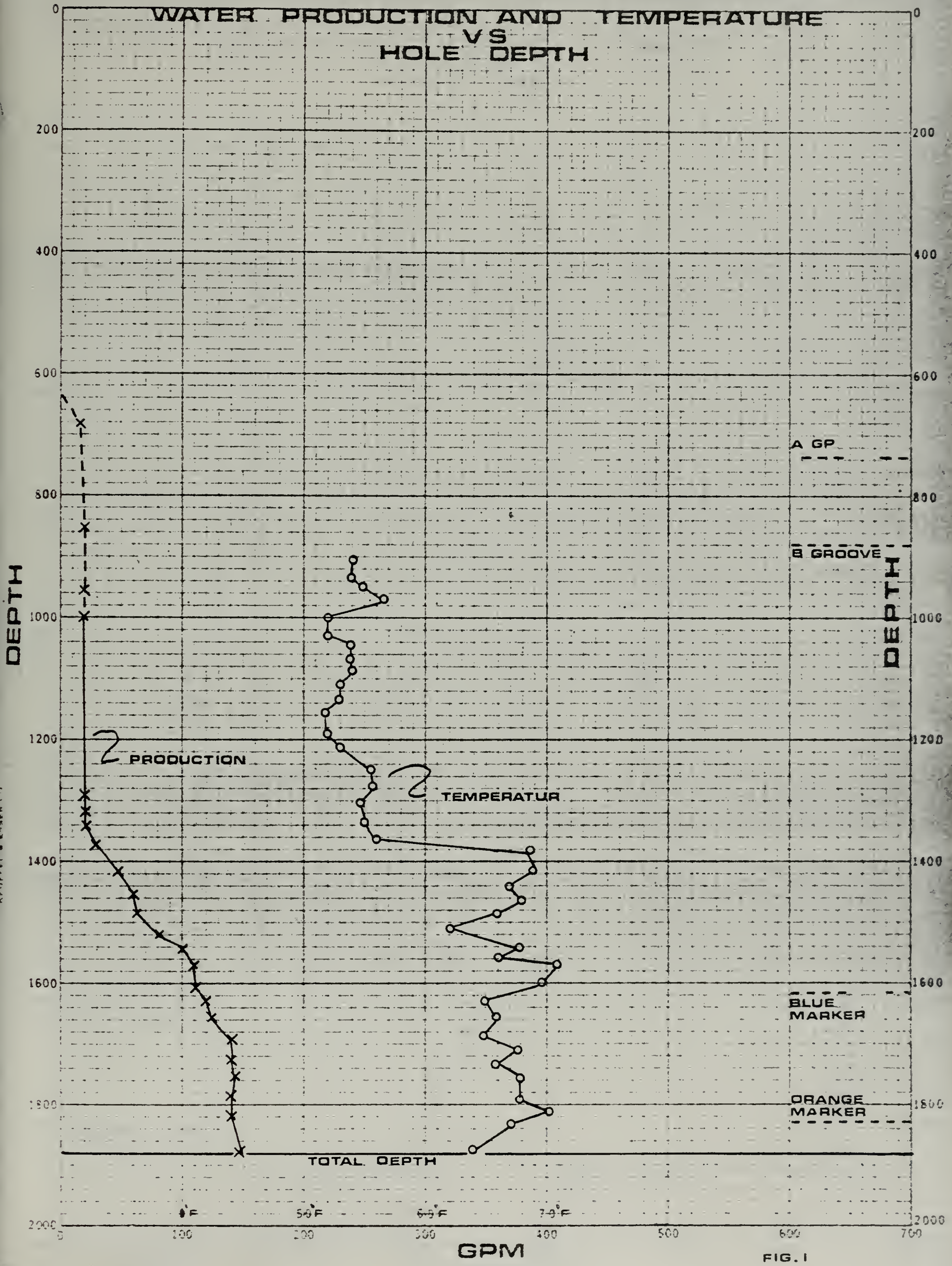
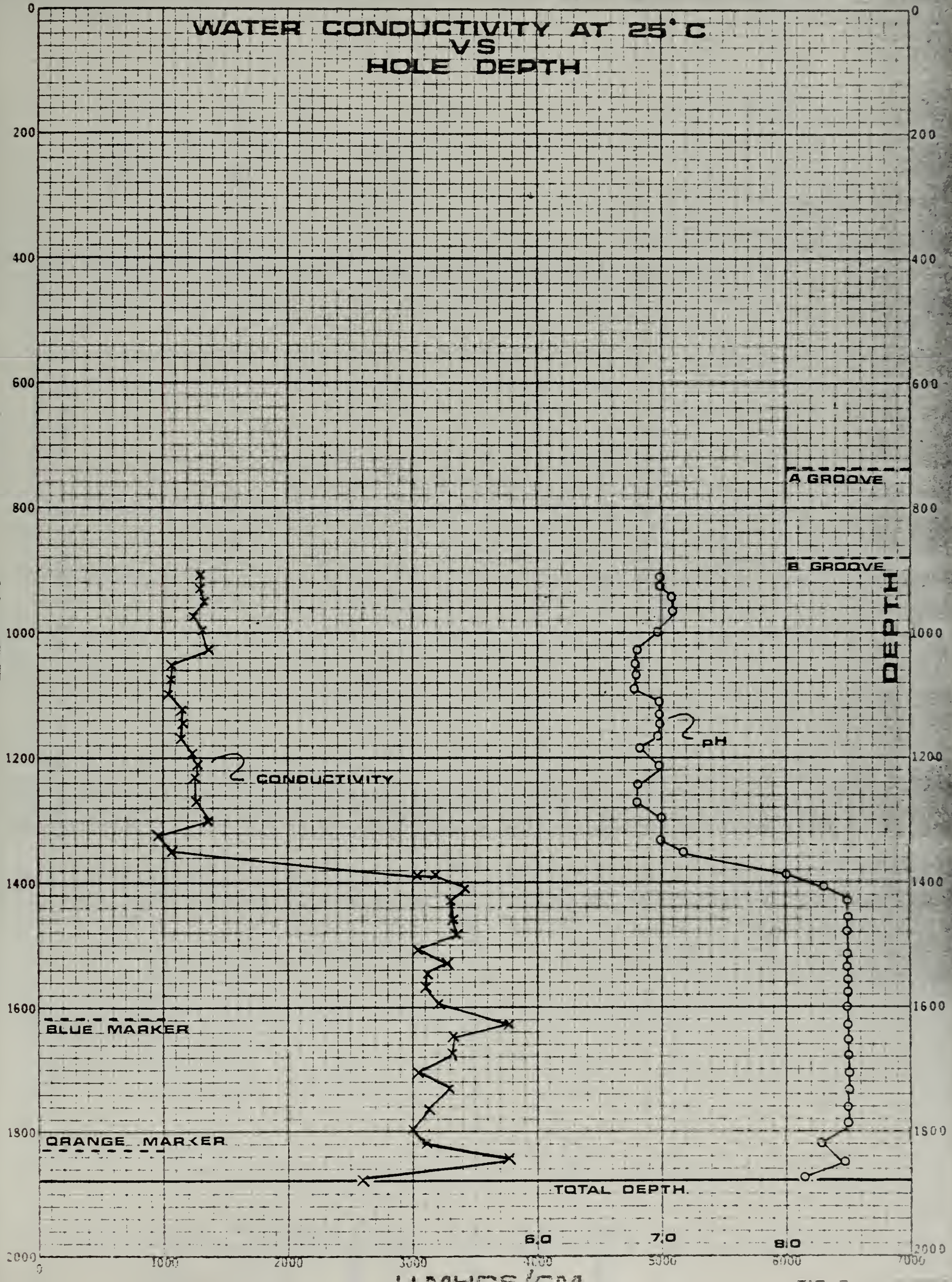

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GP
B GROOVE
PRODUCTION
TEMPERATUR
BLUE MARKER
ORANGE MARKER
TOTAL DEPTH
50°F
60°F
70°F
0
100
200
300
400
500
600
700
GPM

FIG. 1

GS-M-1



KEUFFEL & ESSER CO.

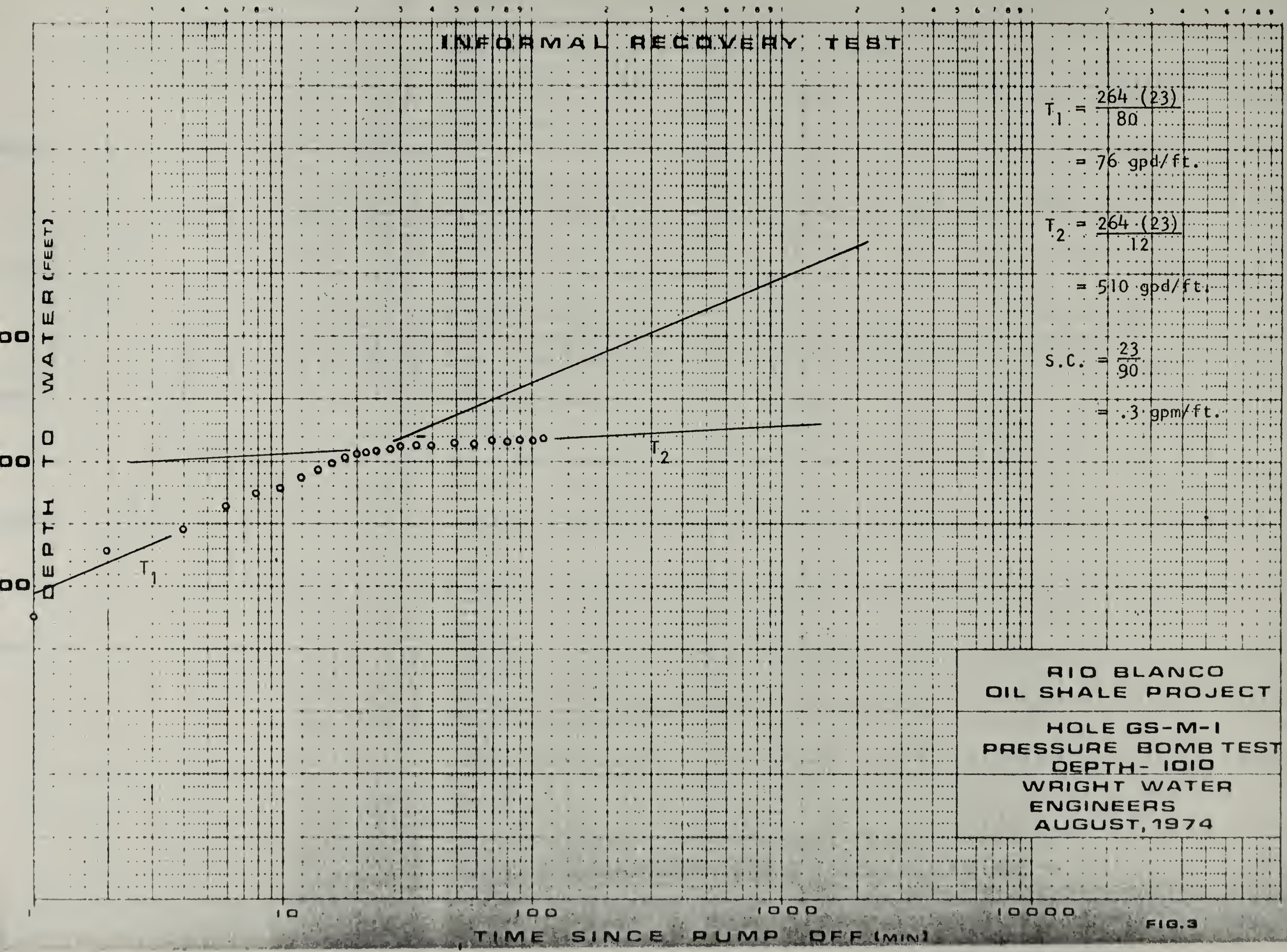
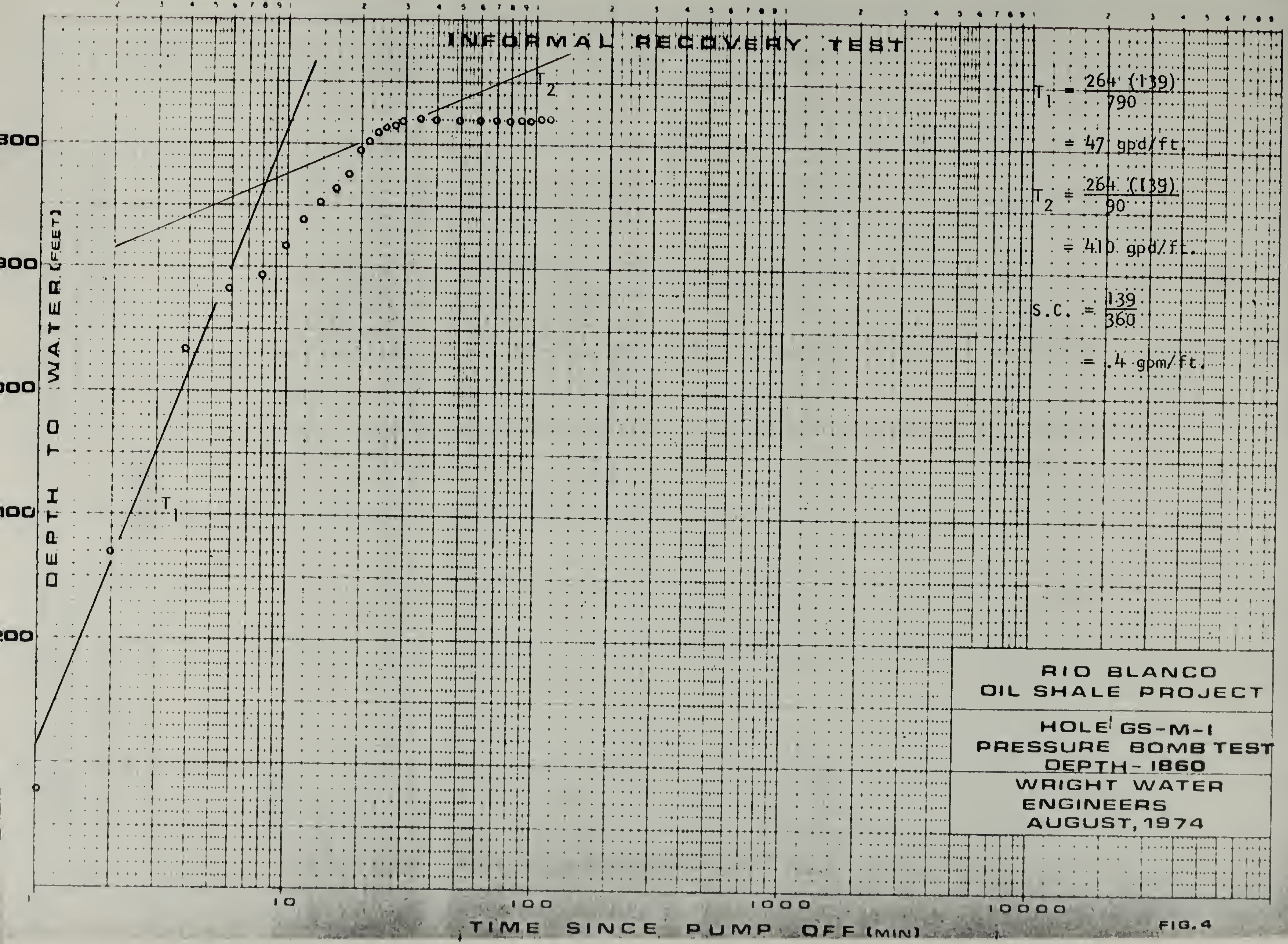
INFORMAL RECOVERY TEST
$T_1 = \frac{264\ (23)}{80}$
$= 76$ gpd/ft.
$T_2 = \frac{264\ (23)}{12}$
$= 510$ gpd/ft.
S.C. $= \frac{23}{90}$
$= .3$ gpm/ft.
T_1
T_2
00
00
00
DEPTH TO WATER (FEET)
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-M-I
PRESSURE BOMB TEST
DEPTH- 1010
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.3



INFORMAL RECOVERY TEST

$T_1 = \frac{264\ (139)}{790}$

= 47 gpd/ft.

$T_2 = \frac{264\ (139)}{90}$

= 410 gpd/ft.

$S.C. = \frac{139}{360}$

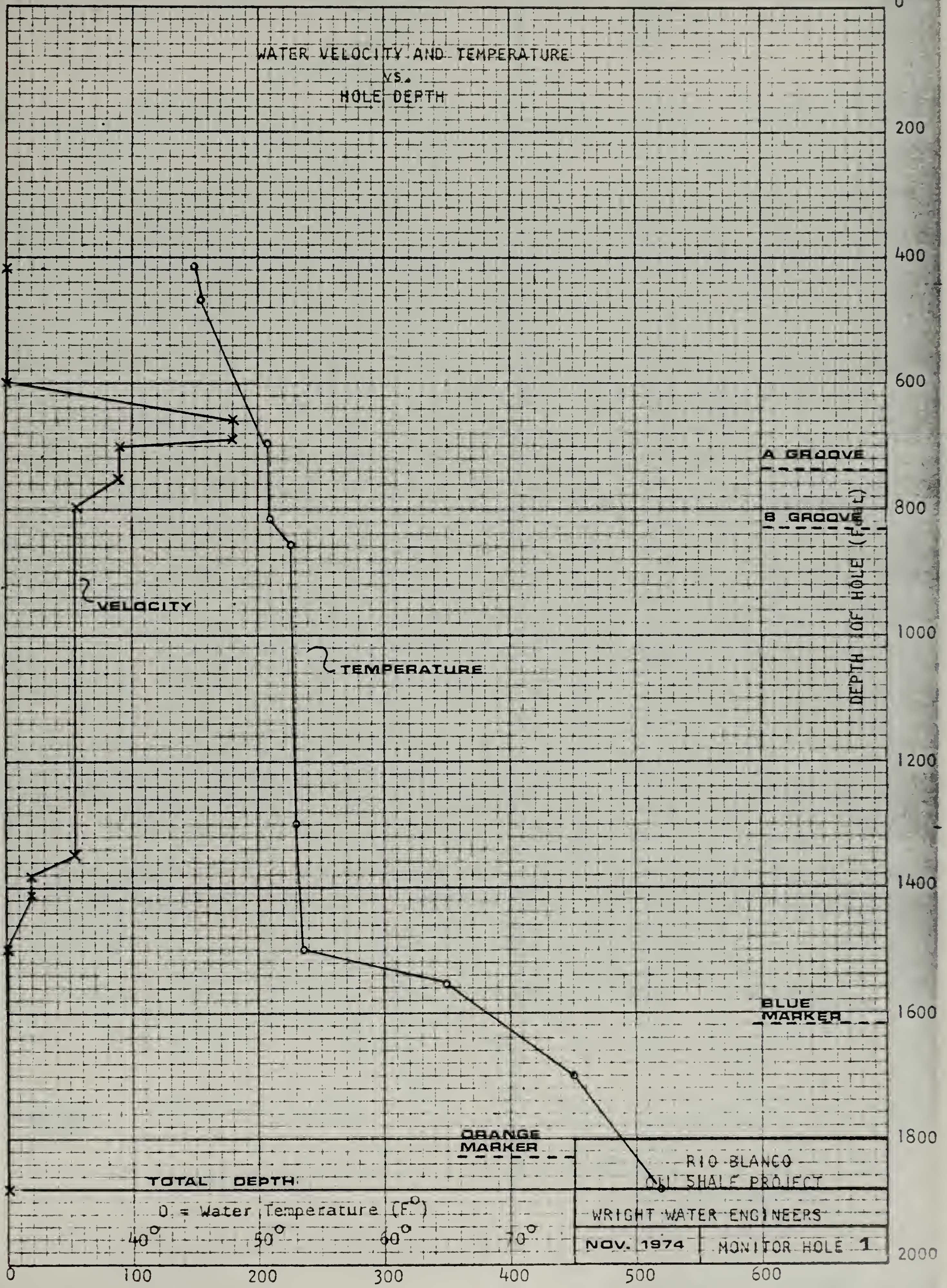
= .4 gpm/ft.

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-M-1
PRESSURE BOMB TEST
DEPTH - 1860

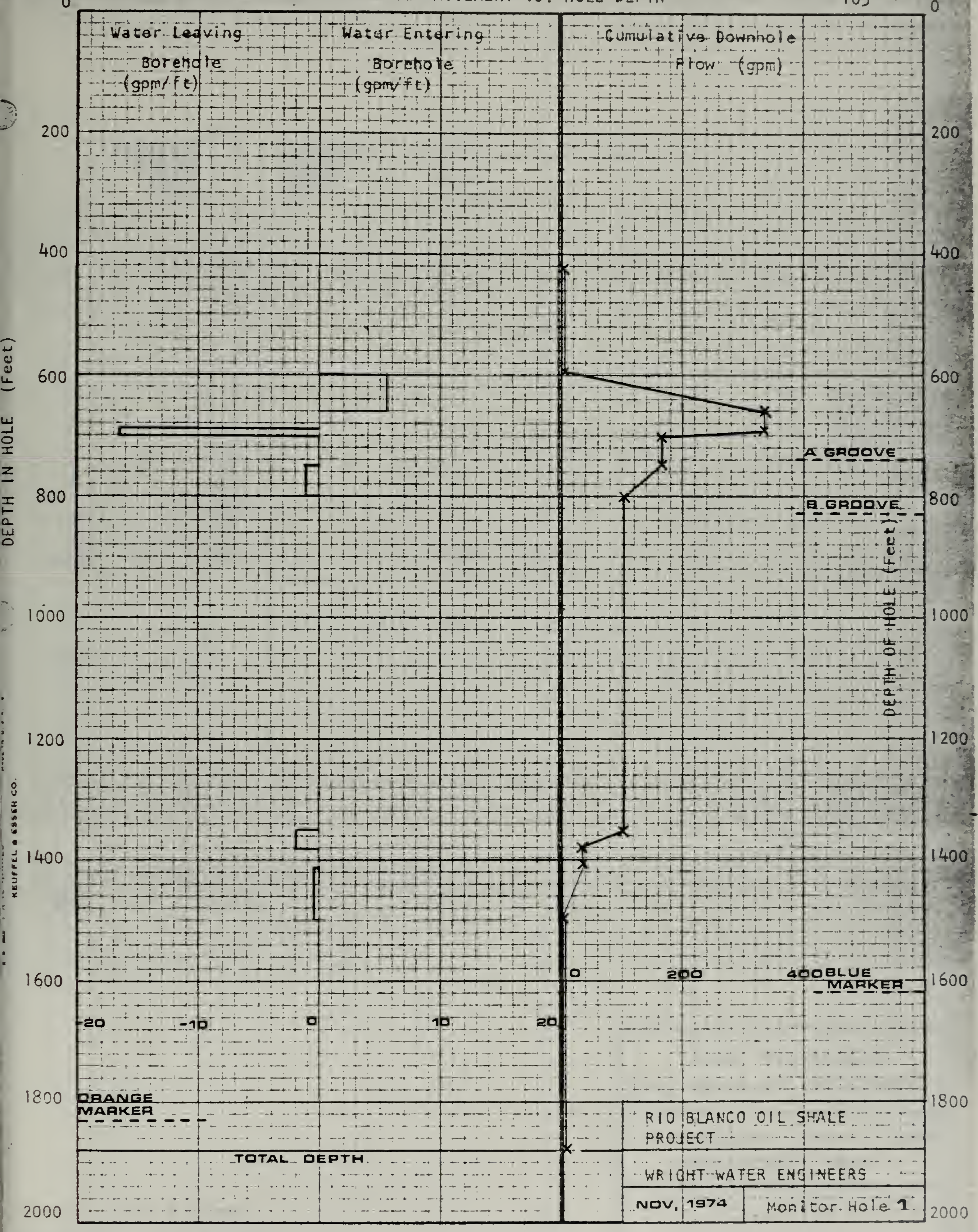
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 4



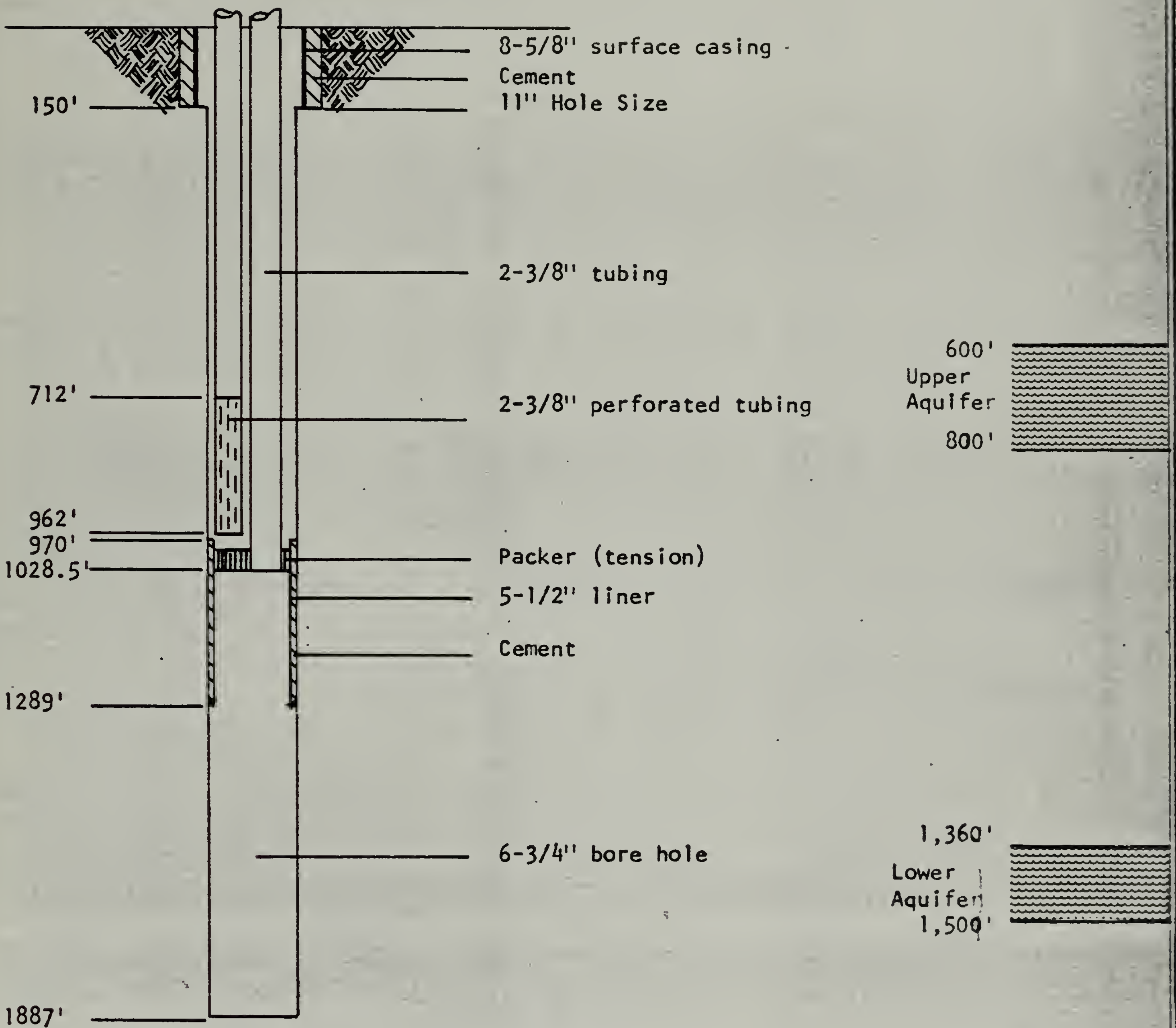
KEUFFEL & ESSER CO.

WATER MOVEMENT VS. HOLE DEPTH



KEUFFEL & ESSER CO.

FIG. 6



RIO BLANCO
OIL SHALE PROJECT

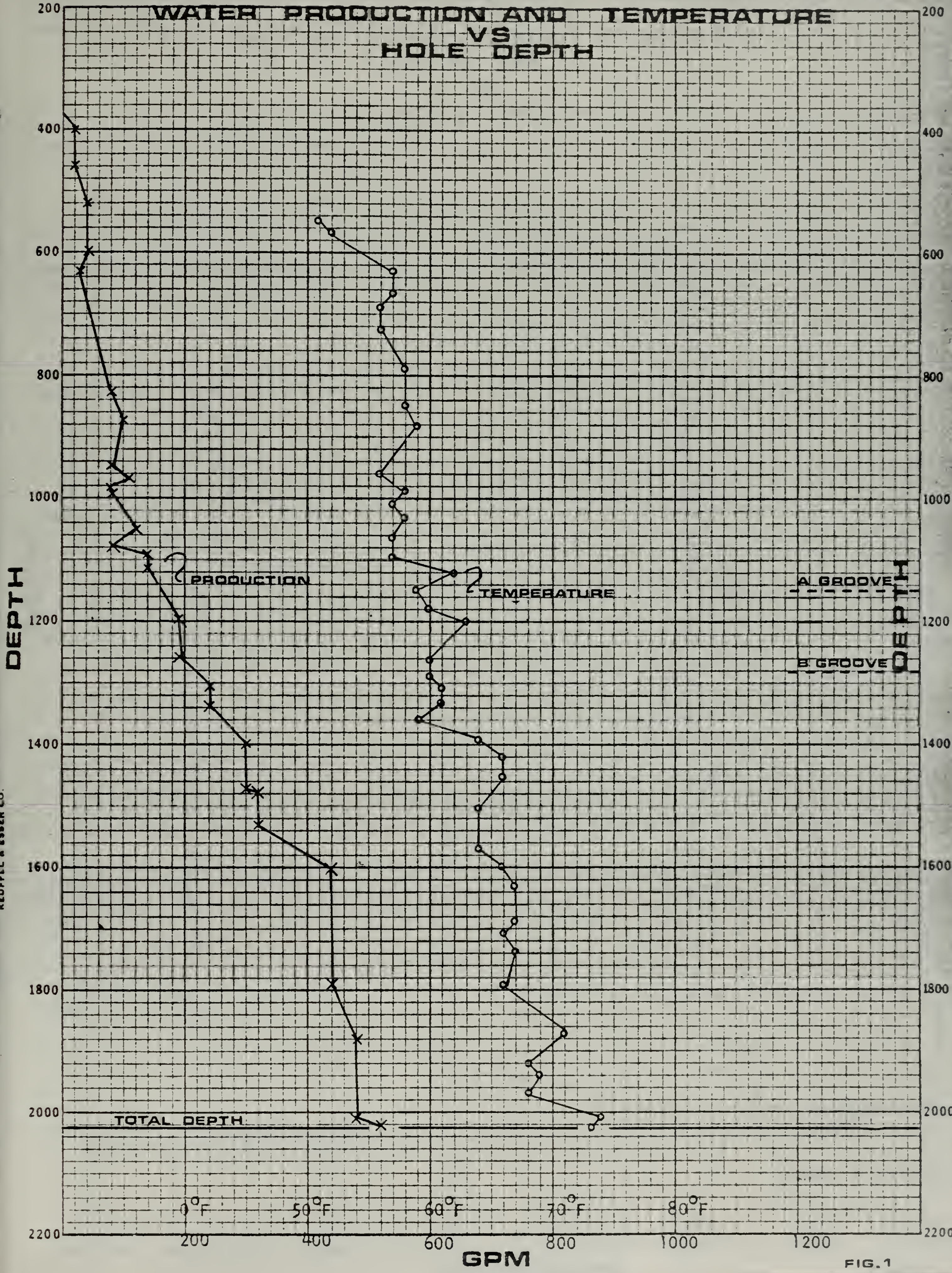
HOLE GS-M-1 DEPTH 1887
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 802

VERITICAL SCALE 1"-300'
HORIZONTAL SCALE 1"-1'-0"

FIG 7

GS-M-2



WATER PRODUCTION AND TEMPERATURE VS HOLE DEPTH

FIG.1

KEUFFEL & ESSER CO.

GS-M-2

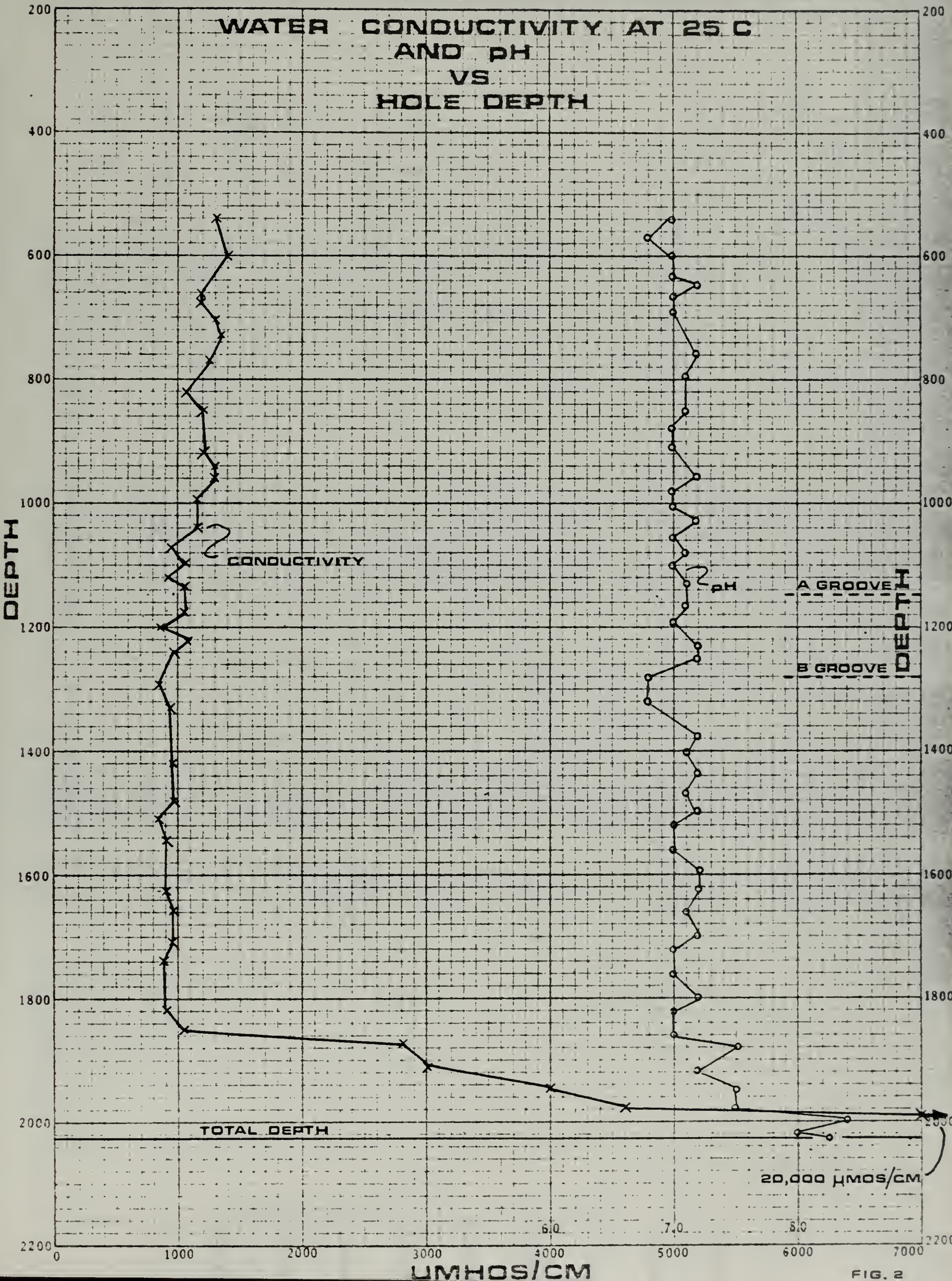
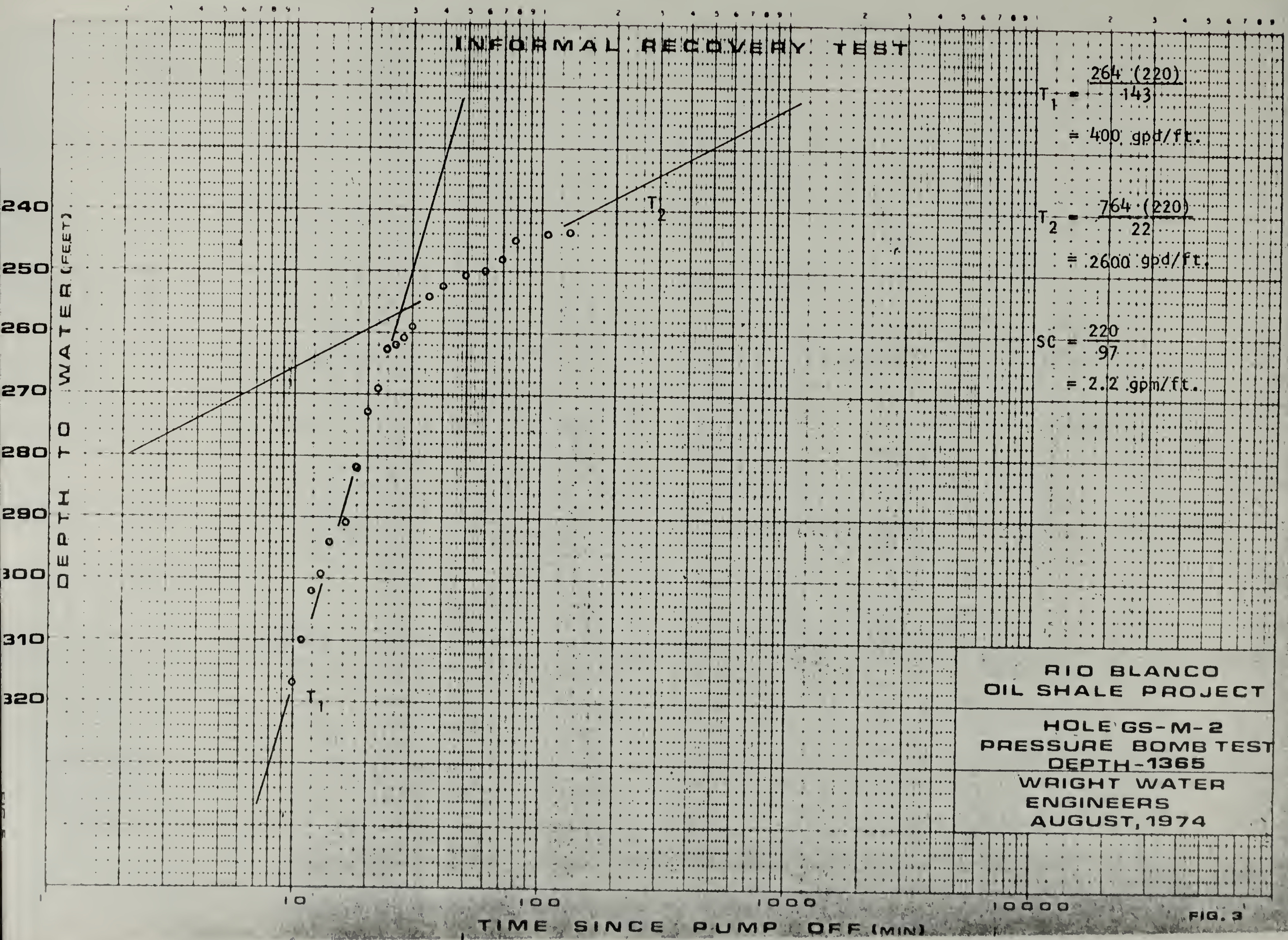


FIG. 2

K&E 5 x 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



INFORMAL RECOVERY TEST

$T_1 = \frac{264\,(220)}{143}$

$= 400$ gpd/ft.

$T_2 = \frac{764\,(220)}{22}$

$= 2600$ gpd/ft.

$SC = \frac{220}{97}$

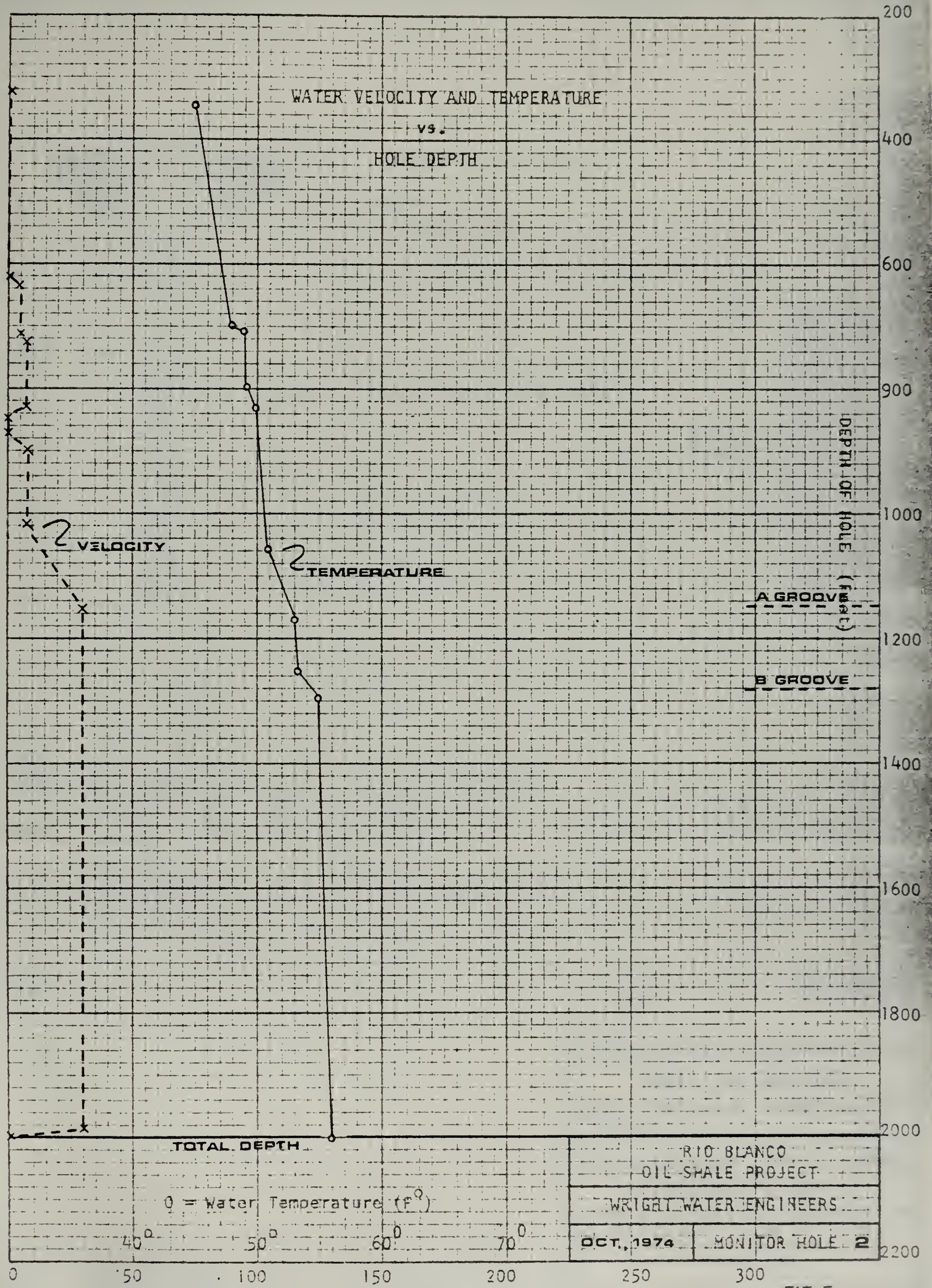
$= 2.2$ gpm/ft.

RIO BLANCO
OIL SHALE PROJECT

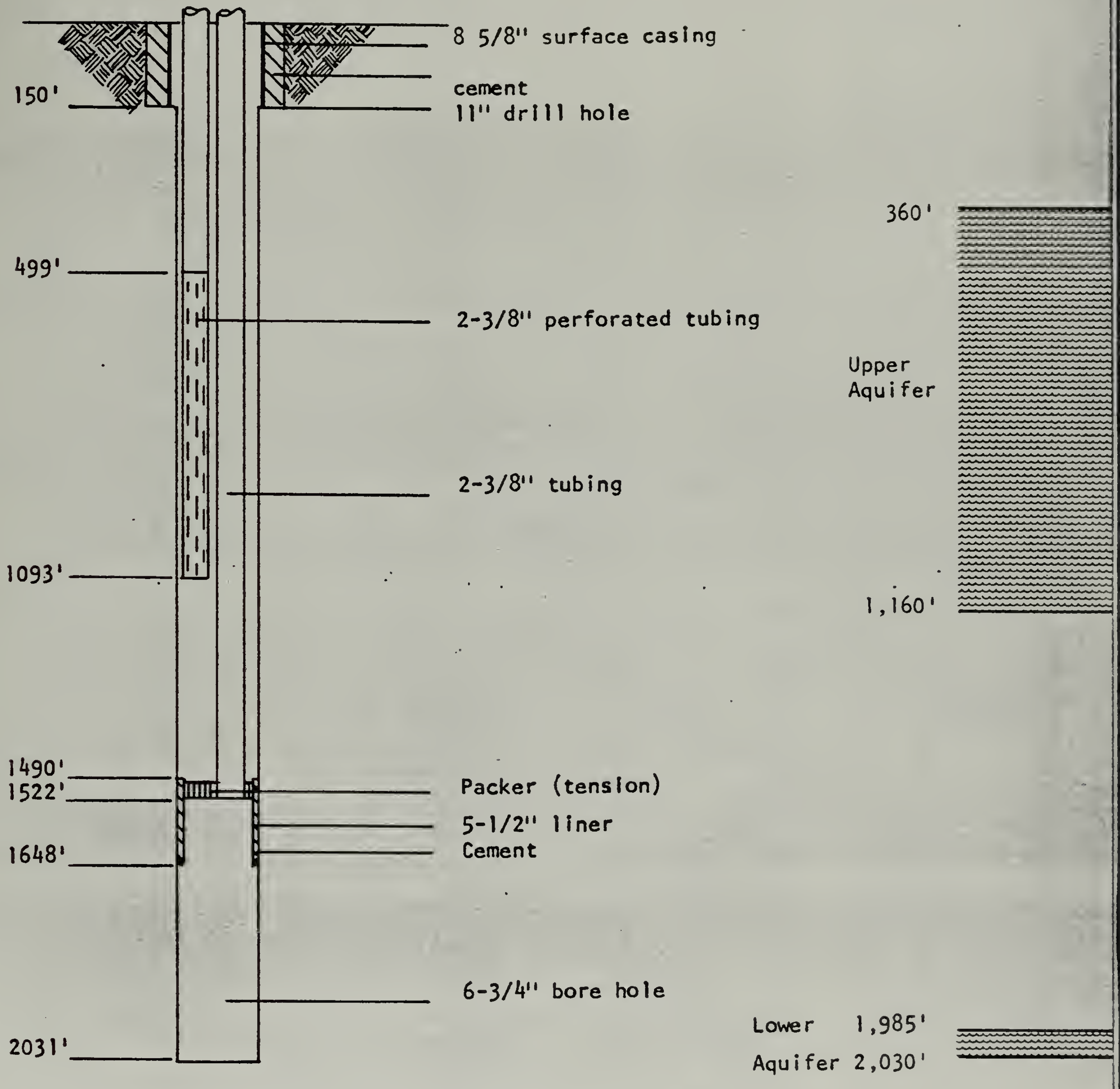
HOLE GS-M-2
PRESSURE BOMB TEST
DEPTH-1365

WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3



KEUFFEL & ESSER CO.



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-M-2 DEPTH 2031
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"-300'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

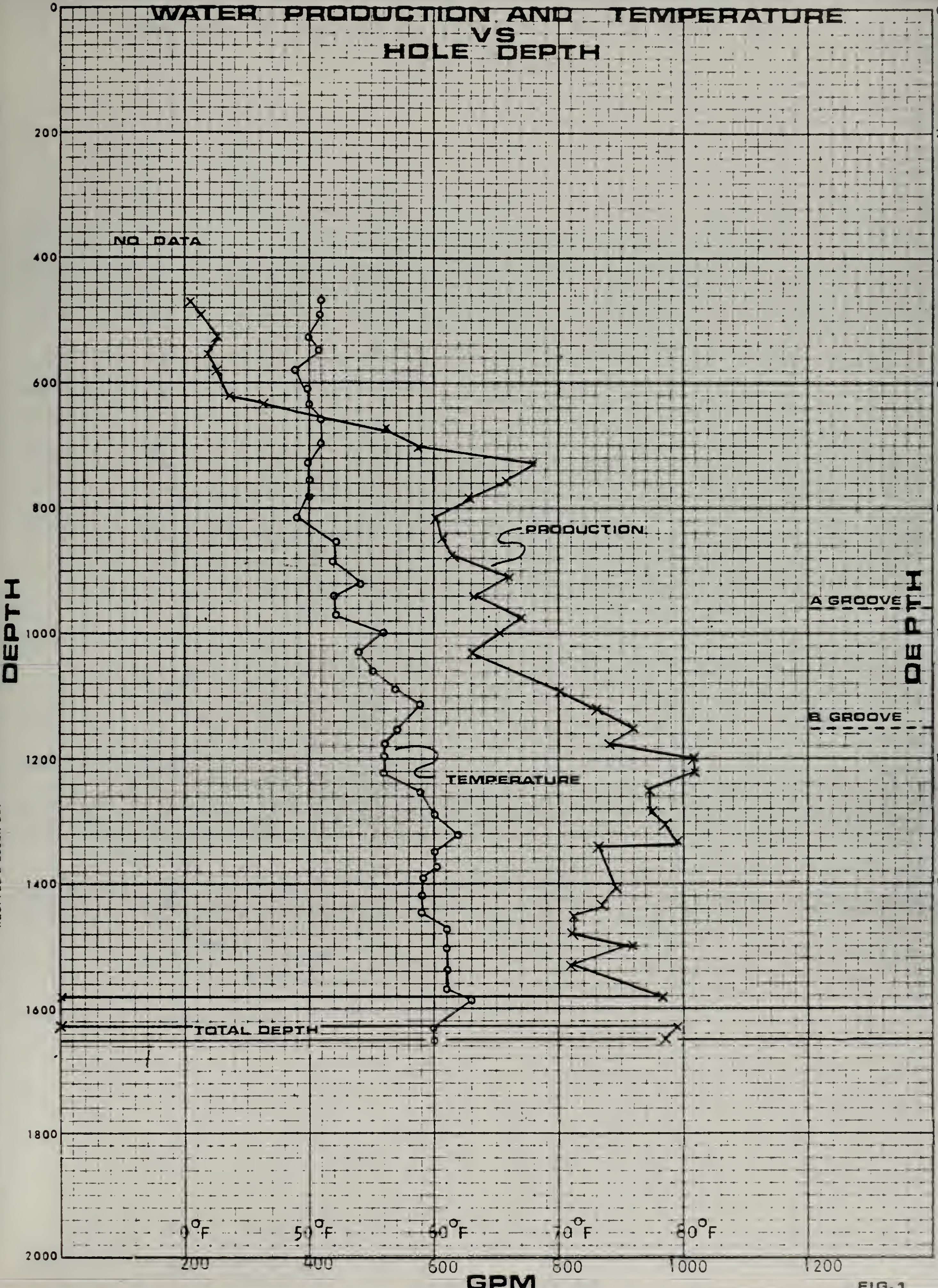
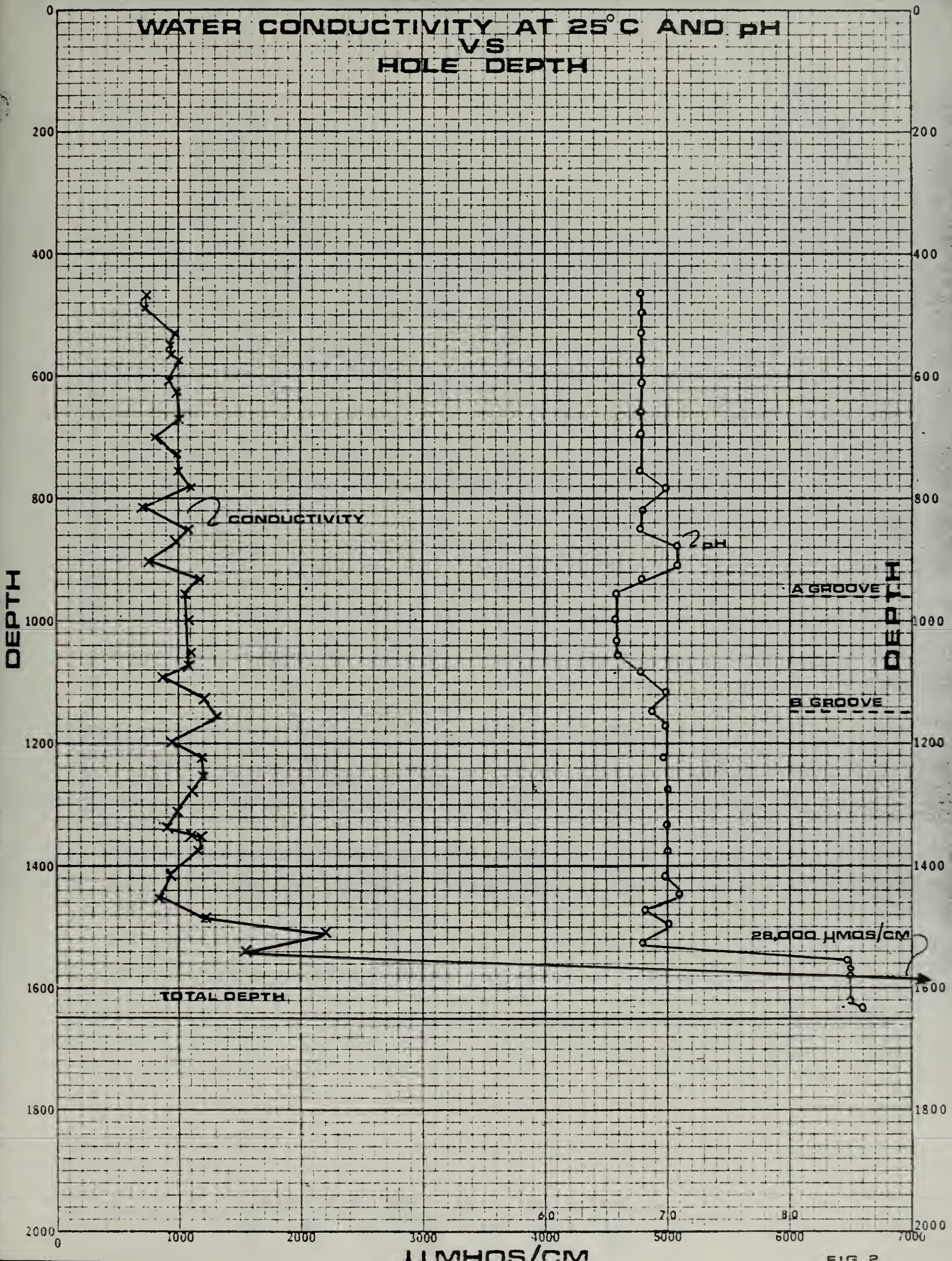


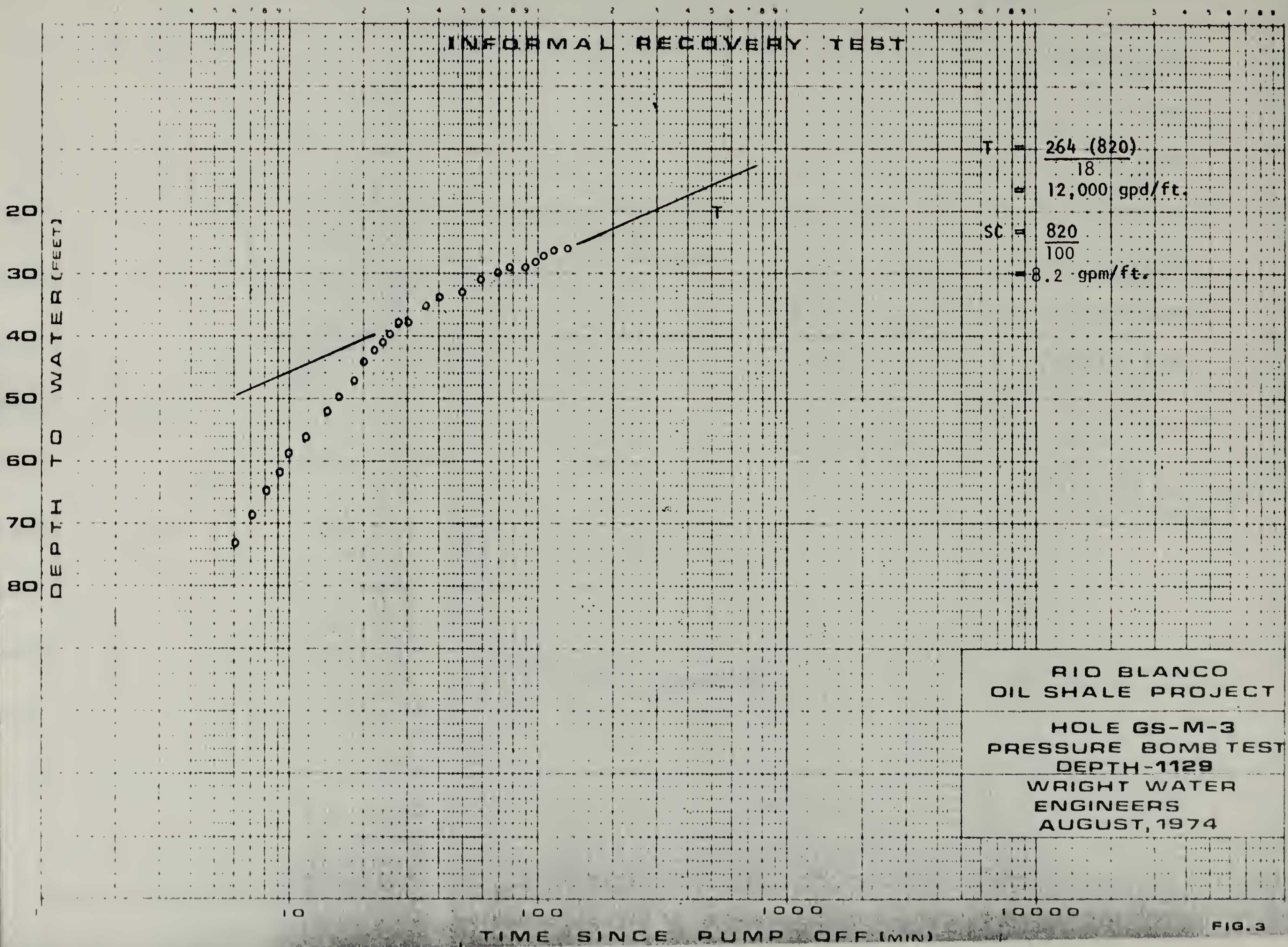
FIG.1

K-E 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



KEUFFEL & ESSER CO

FIG 2



INFORMAL RECOVERY TEST

$T = \frac{264\ (820)}{18}$

$= 12,000$ gpd/ft.

$SC = \frac{820}{100}$

$= 8.2$ gpm/ft.

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-M-3
PRESSURE BOMB TEST
DEPTH-1129

WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG. 3

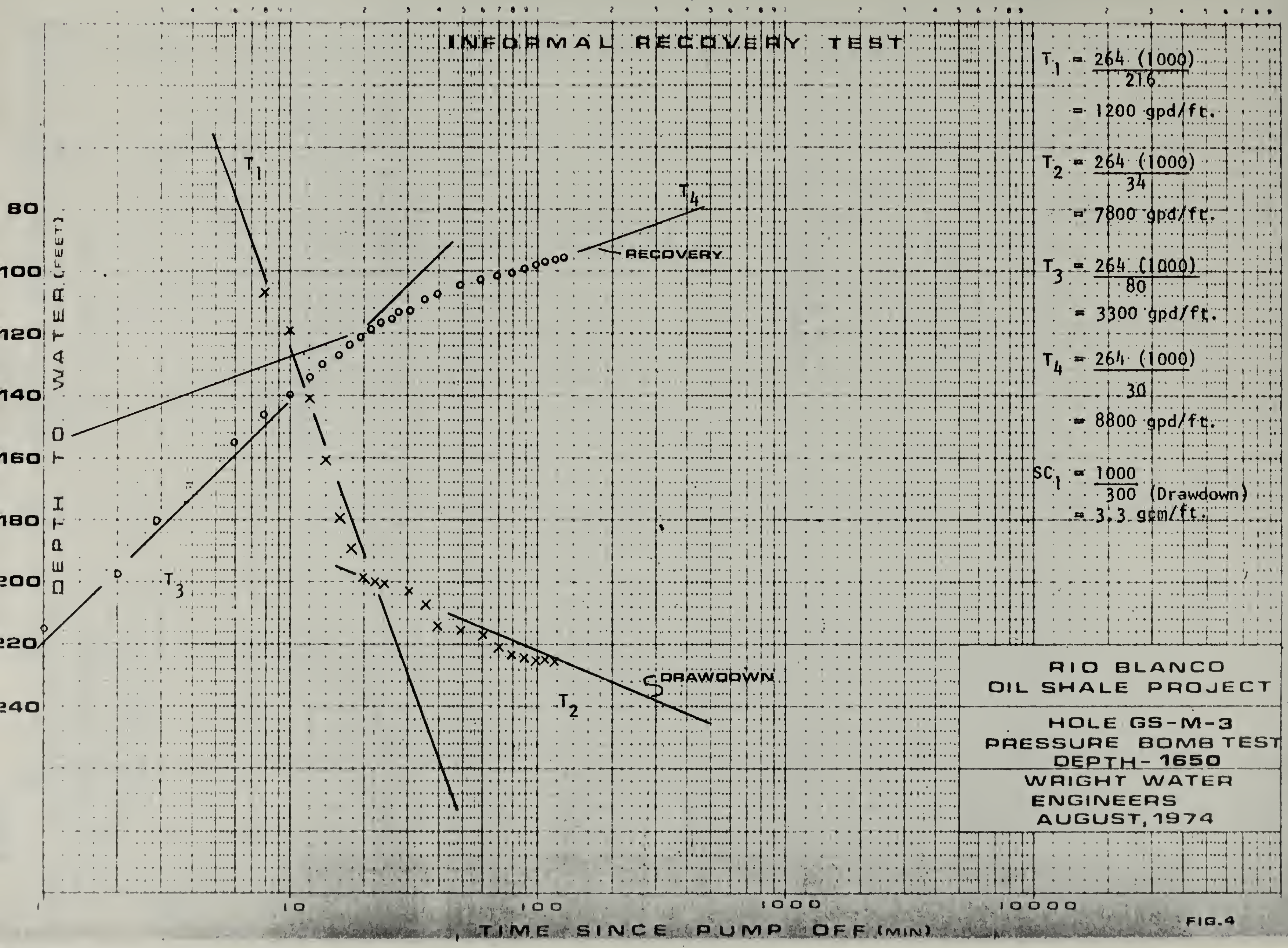

INFORMAL RECOVERY TEST
$T_1 = \frac{264\ (1000)}{216}$
= 1200 gpd/ft.
$T_2 = \frac{264\ (1000)}{34}$
= 7800 gpd/ft.
$T_3 = \frac{264\ (1000)}{80}$
= 3300 gpd/ft.
$T_4 = \frac{264\ (1000)}{30}$
= 8800 gpd/ft.
$SC_1 = \frac{1000}{300}$ (Drawdown)
= 3.3 gpm/ft.
T_1
T_2
T_3
T_4
RECOVERY
DRAWDOWN
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-M-3
PRESSURE BOMB TEST
DEPTH - 1650
WRIGHT WATER
ENGINEERS
AUGUST, 1974
DEPTH TO WATER (FEET)
80
100
120
140
160
180
200
220
240
1
10
100
1000
10000
TIME SINCE PUMP OFF (MIN)

FIG. 4

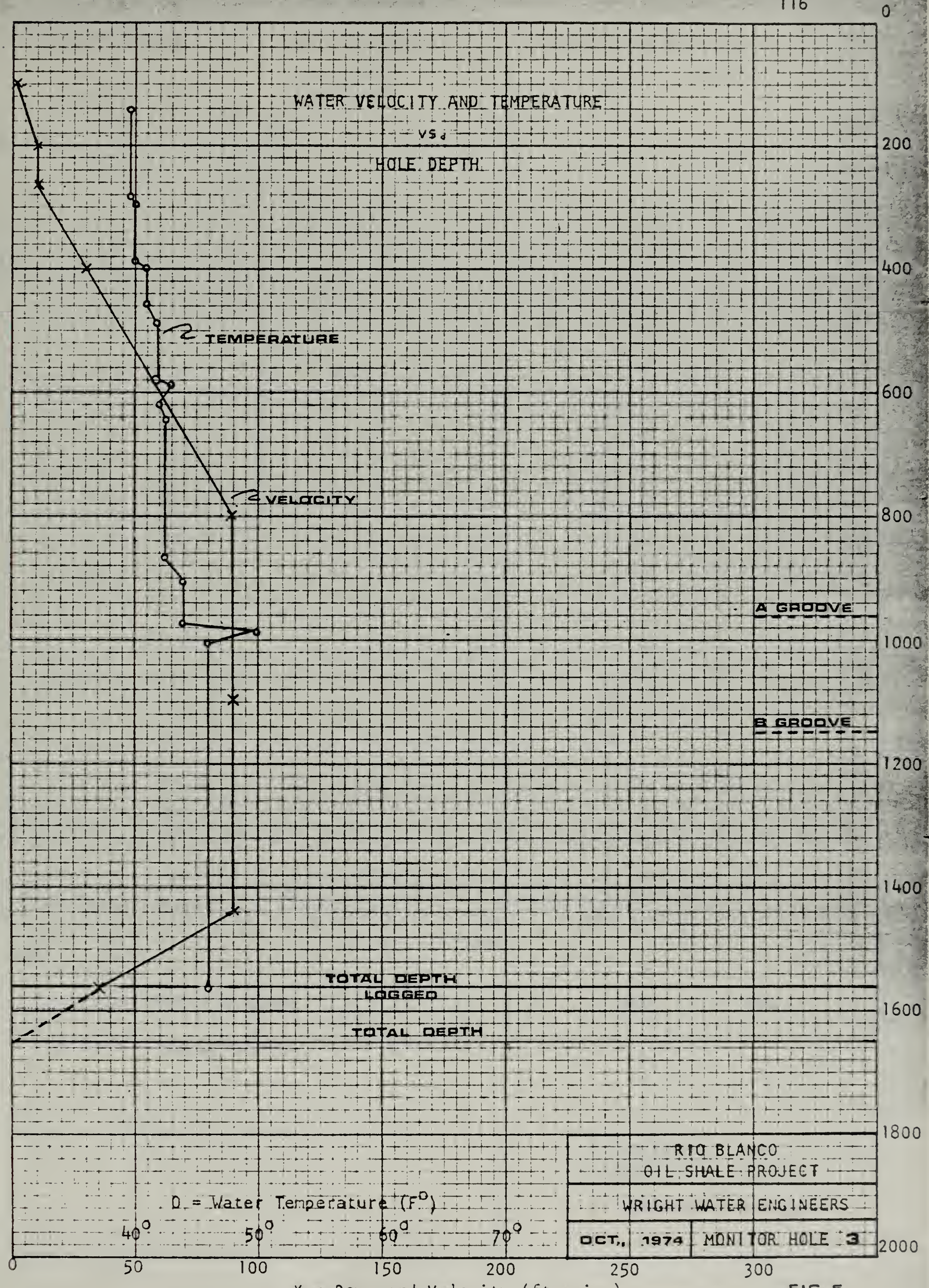


FIG. 5

KEUFFEL & ESSER CO.

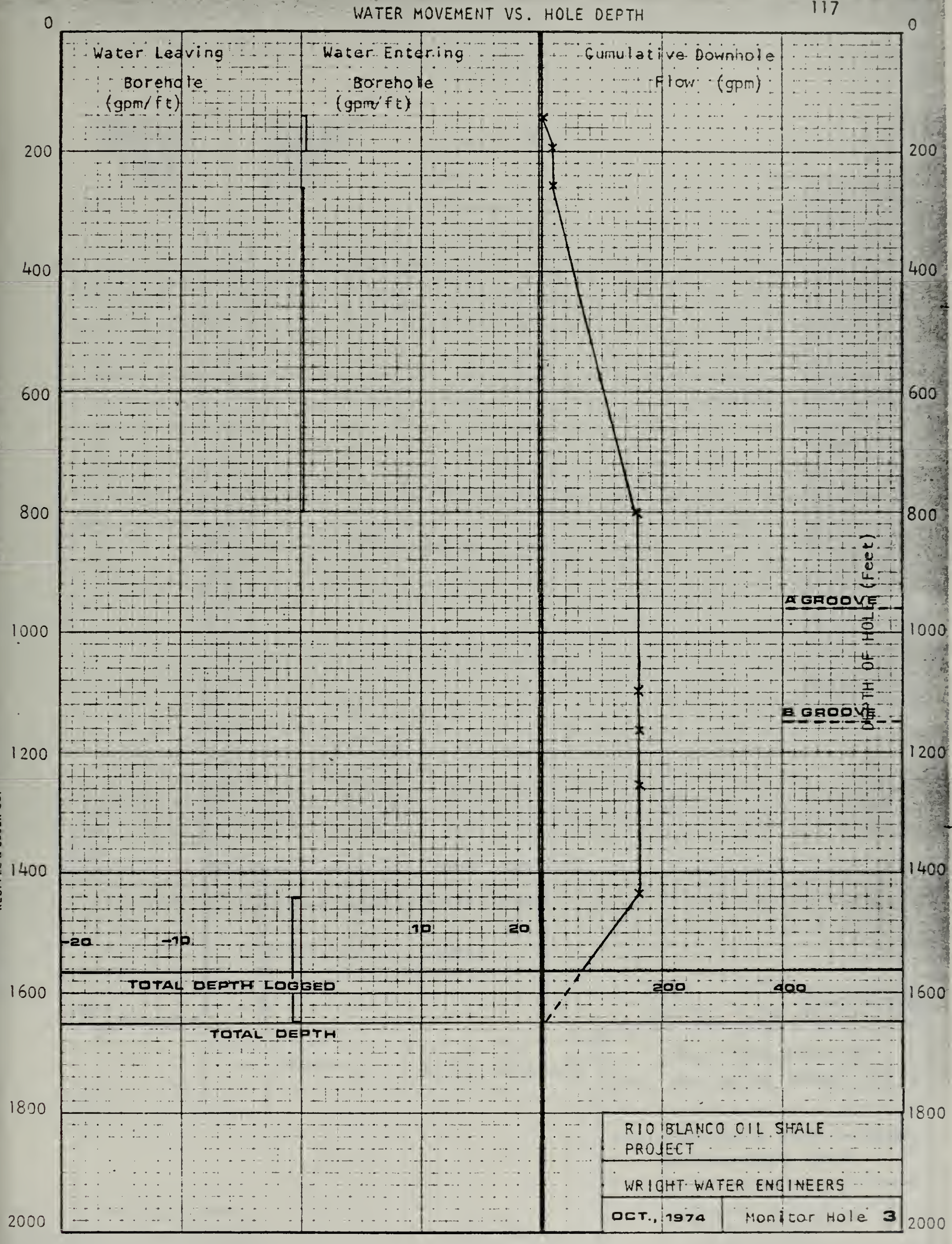
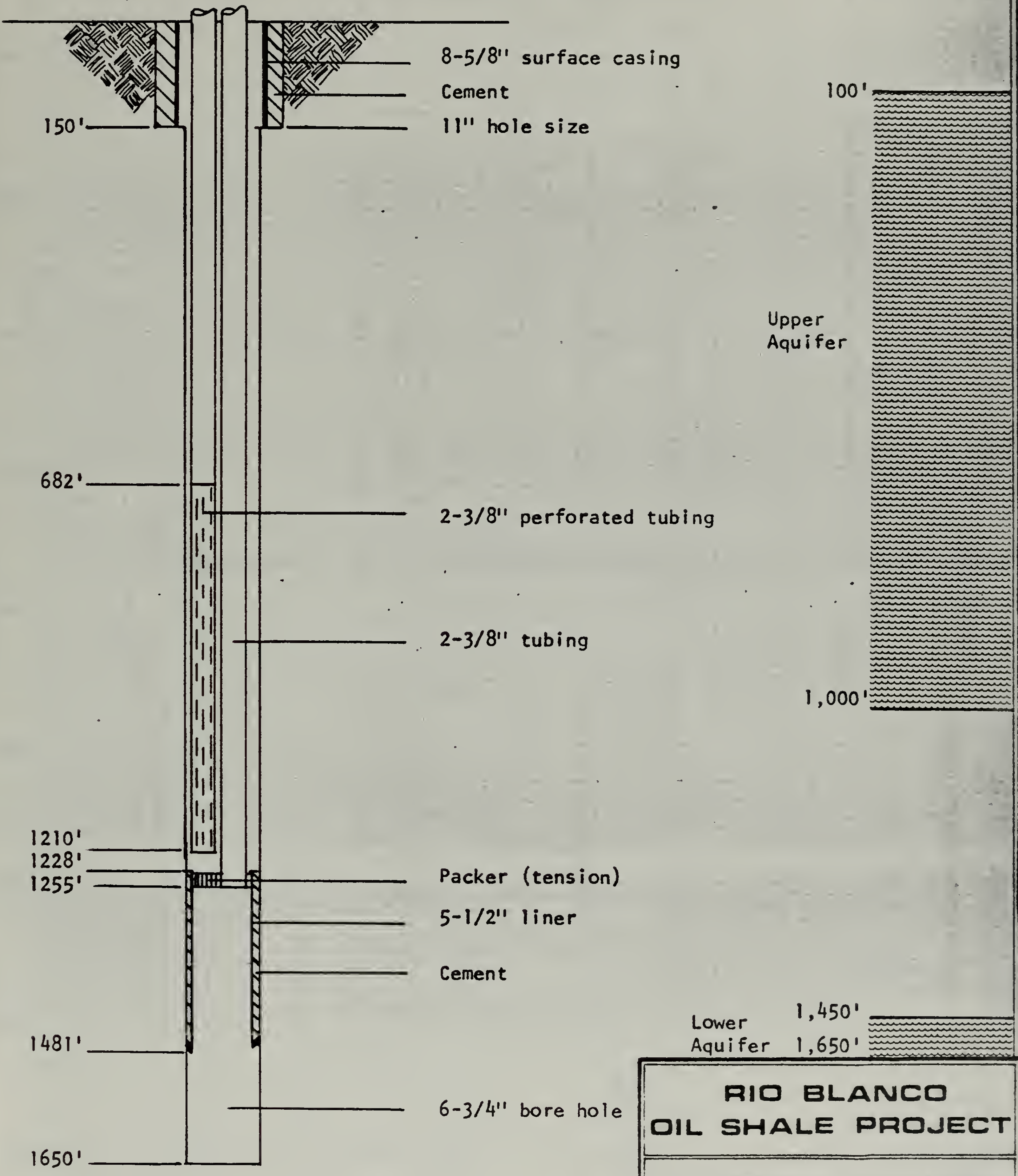

WATER MOVEMENT VS. HOLE DEPTH
Water Leaving Borehole (gpm/ft)
Water Entering Borehole (gpm/ft)
Cumulative Downhole Flow (gpm)
DEPTH IN HOLE (Feet)
DEPTH OF HOLE (Feet)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
-20
-10
10
20
200
400
A GROOVE
B GROOVE
TOTAL DEPTH LOGGED
TOTAL DEPTH
RIO BLANCO OIL SHALE PROJECT
WRIGHT WATER ENGINEERS
OCT., 1974
Monitor Hole 3

FIG. 6



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-M-3 DEPTH 1650
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC.
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"- 200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

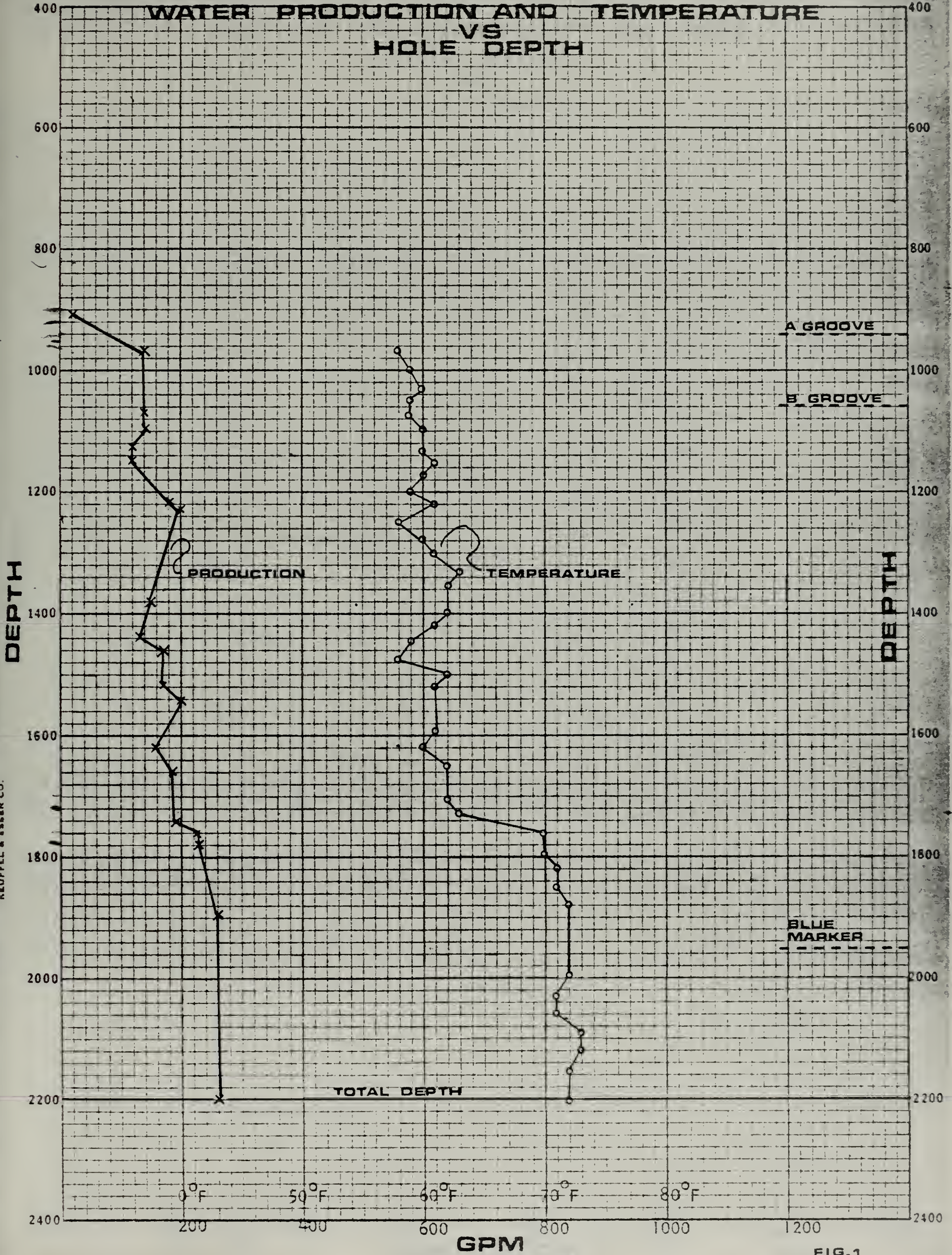


FIG.1

K+E 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

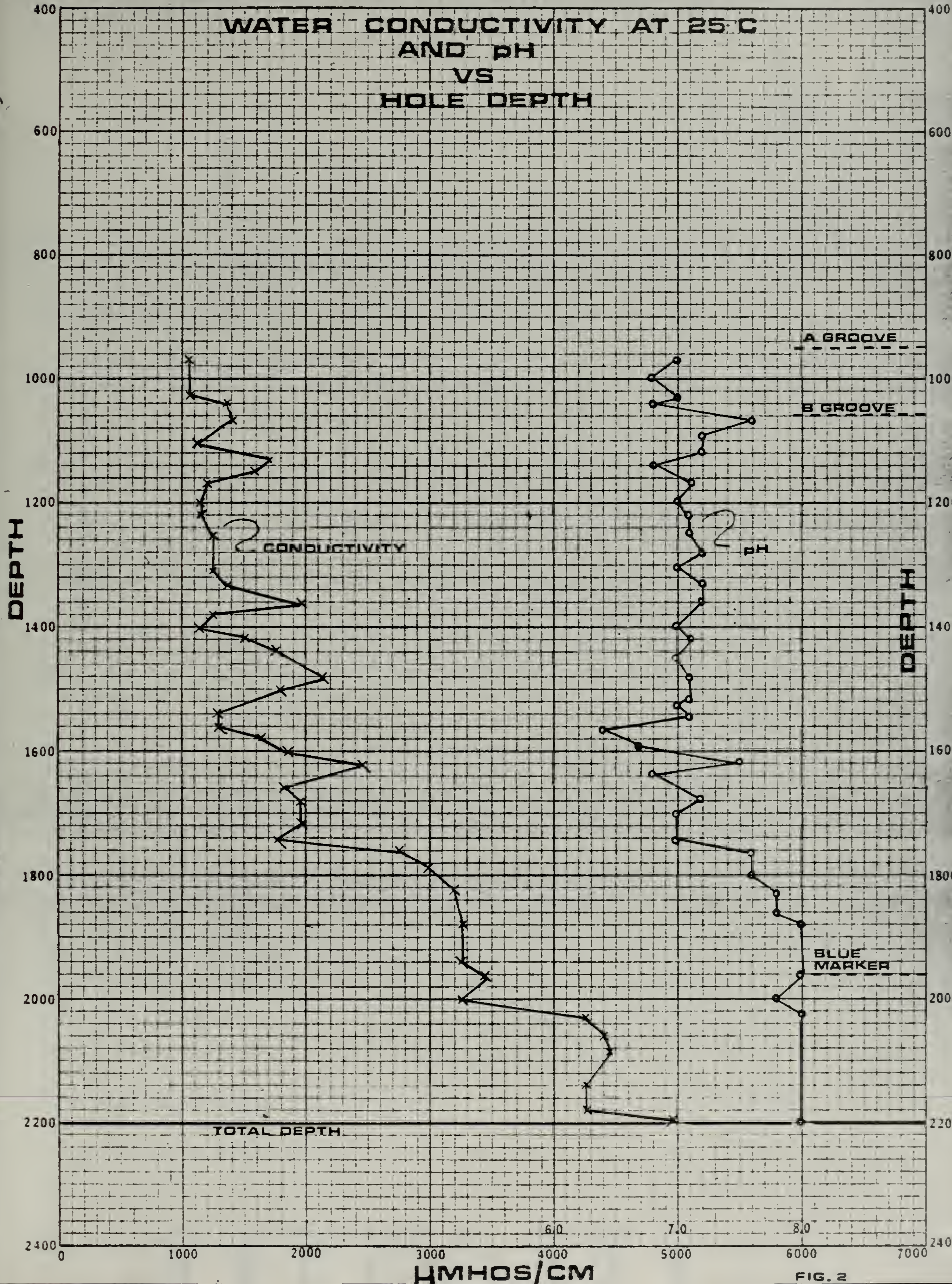


FIG. 2

KEUFFEL & ESSER CO. 7 X 10 INCHES MADE IN U.S.A.

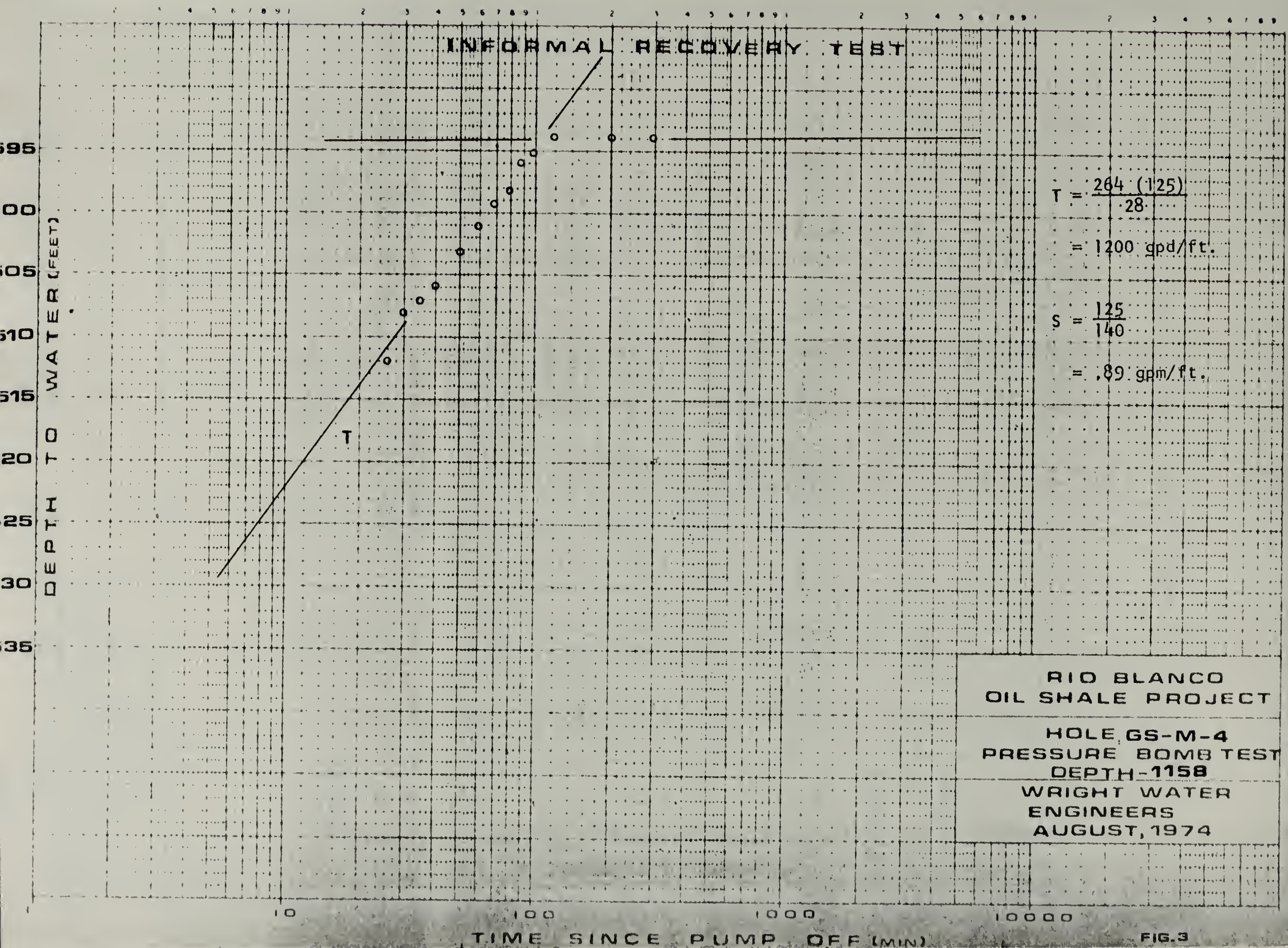

INFORMAL RECOVERY TEST
T = $\frac{264\ (125)}{28}$
= 1200 gpd/ft.
S = $\frac{125}{140}$
= .89 gpm/ft.
T
DEPTH TO WATER (FEET)
595
00
505
510
515
20
25
30
35
TIME SINCE PUMP OFF (MIN)
10
100
1000
10000
RIO BLANCO
OIL SHALE PROJECT
HOLE GS-M-4
PRESSURE BOMB TEST
DEPTH-1158
WRIGHT WATER
ENGINEERS
AUGUST, 1974

FIG.3

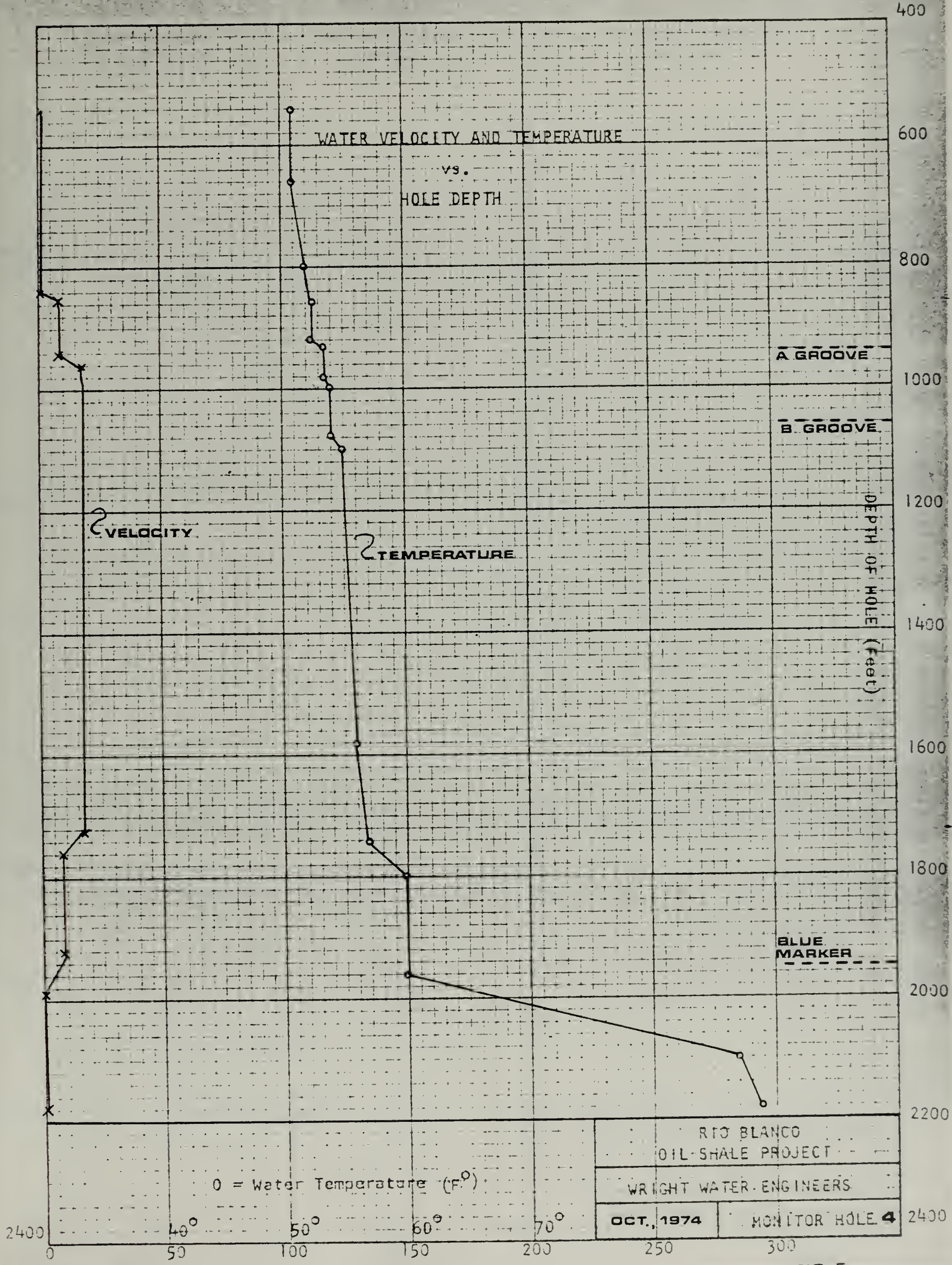
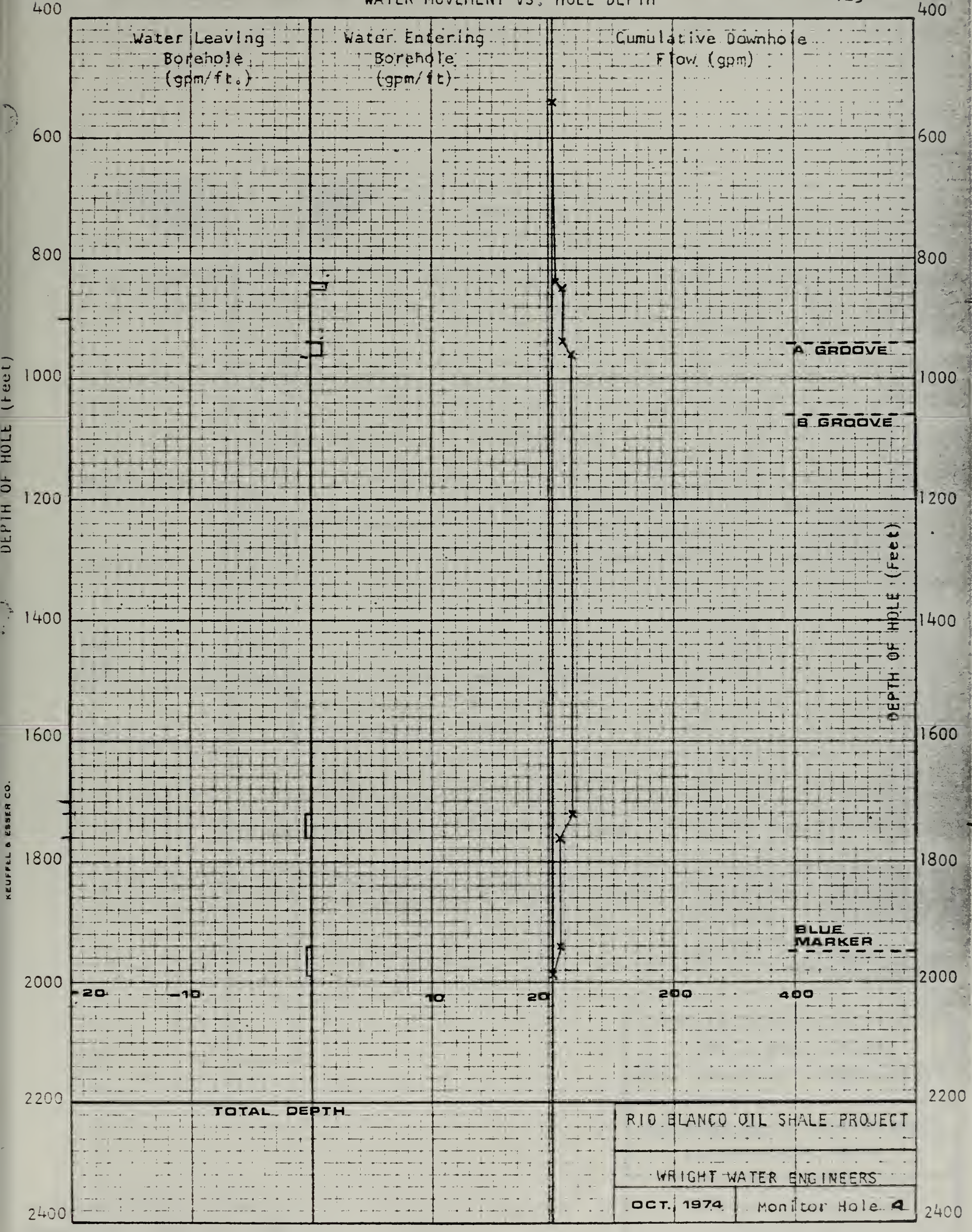


FIG. 5

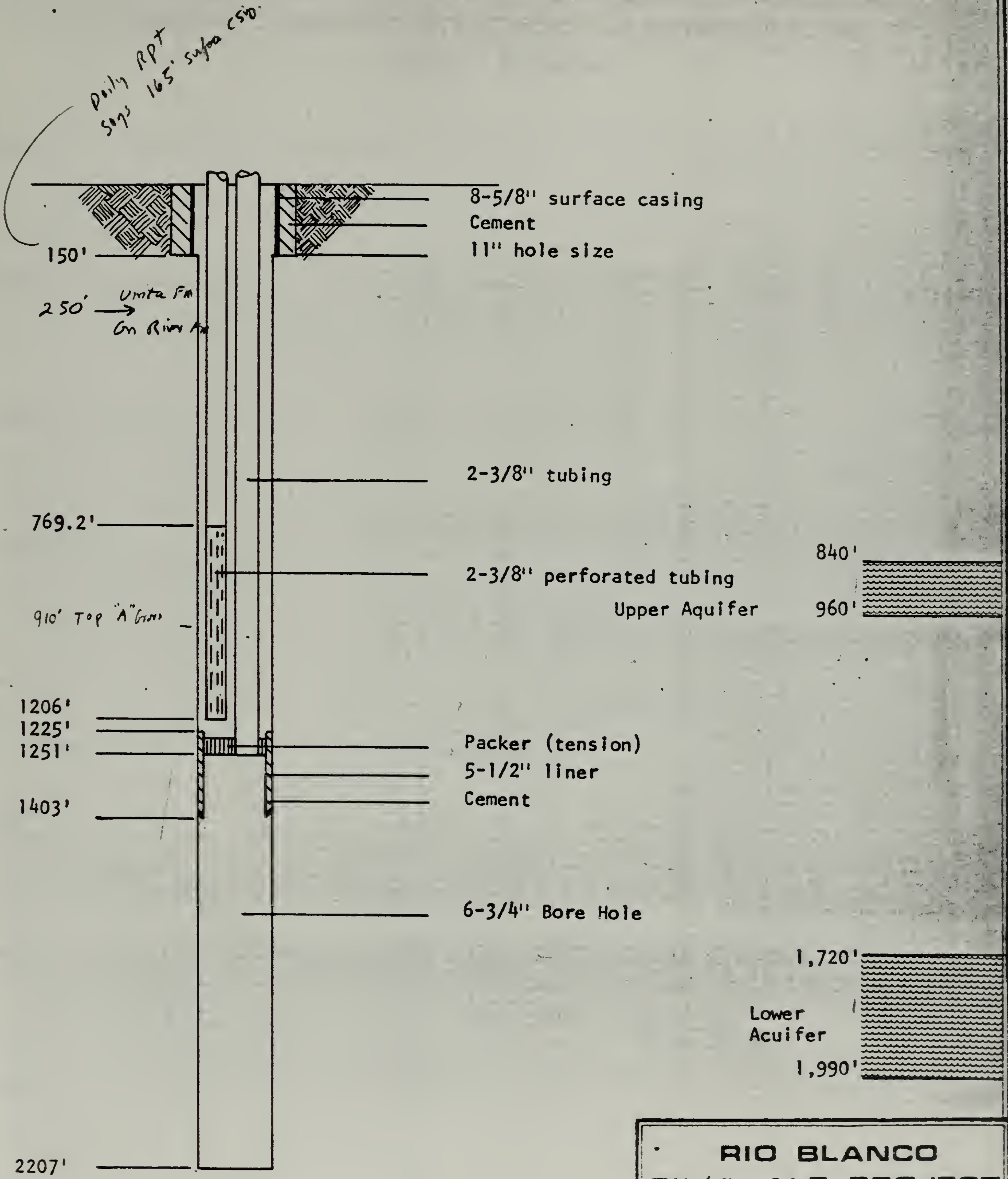
KEUFFEL & ESSER CO.

WATER MOVEMENT VS. HOLE DEPTH



KEUFFEL & ESSER CO.

FIG.6



RIO BLANCO
OIL′SHALE PROJECT

HOLE GS-M-4 DEPTH 2207
DECEMBER, 1974

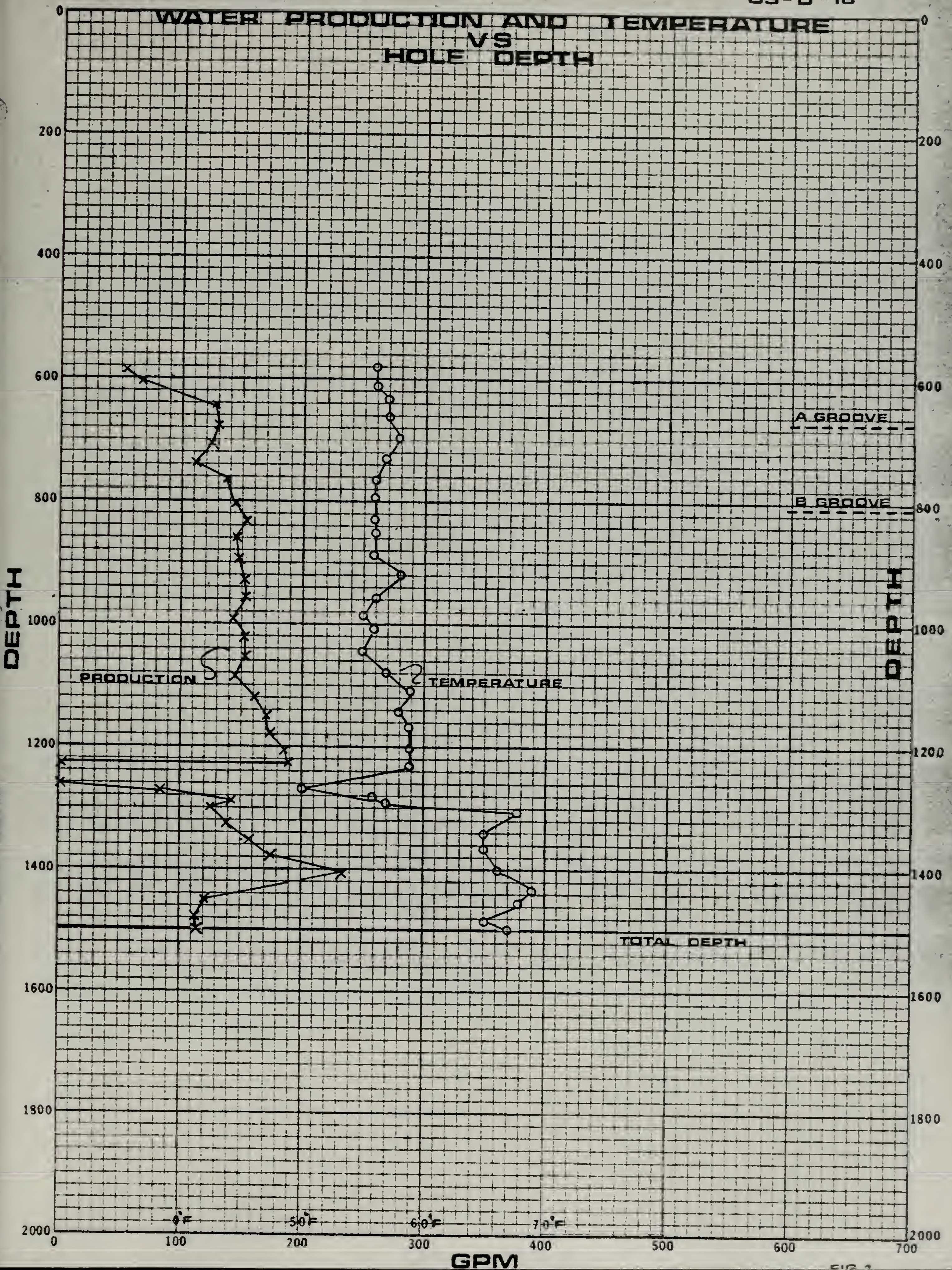
WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"~300'

HORIZONTAL SCALE 1"-1'-0"

FIG. 7

GS-D-16



WATER PRODUCTION AND TEMPERATURE VS HOLE DEPTH

GS-D-16

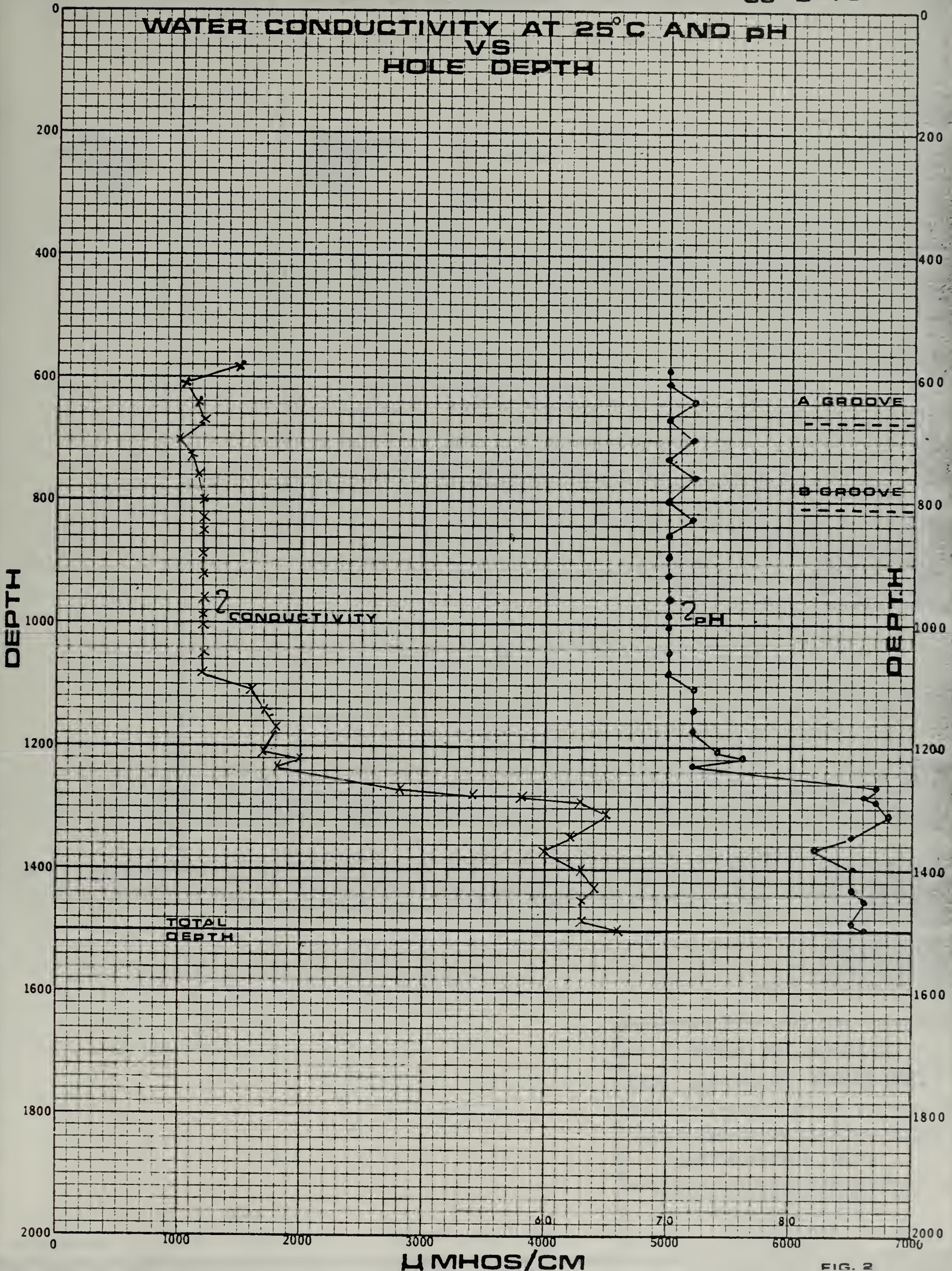
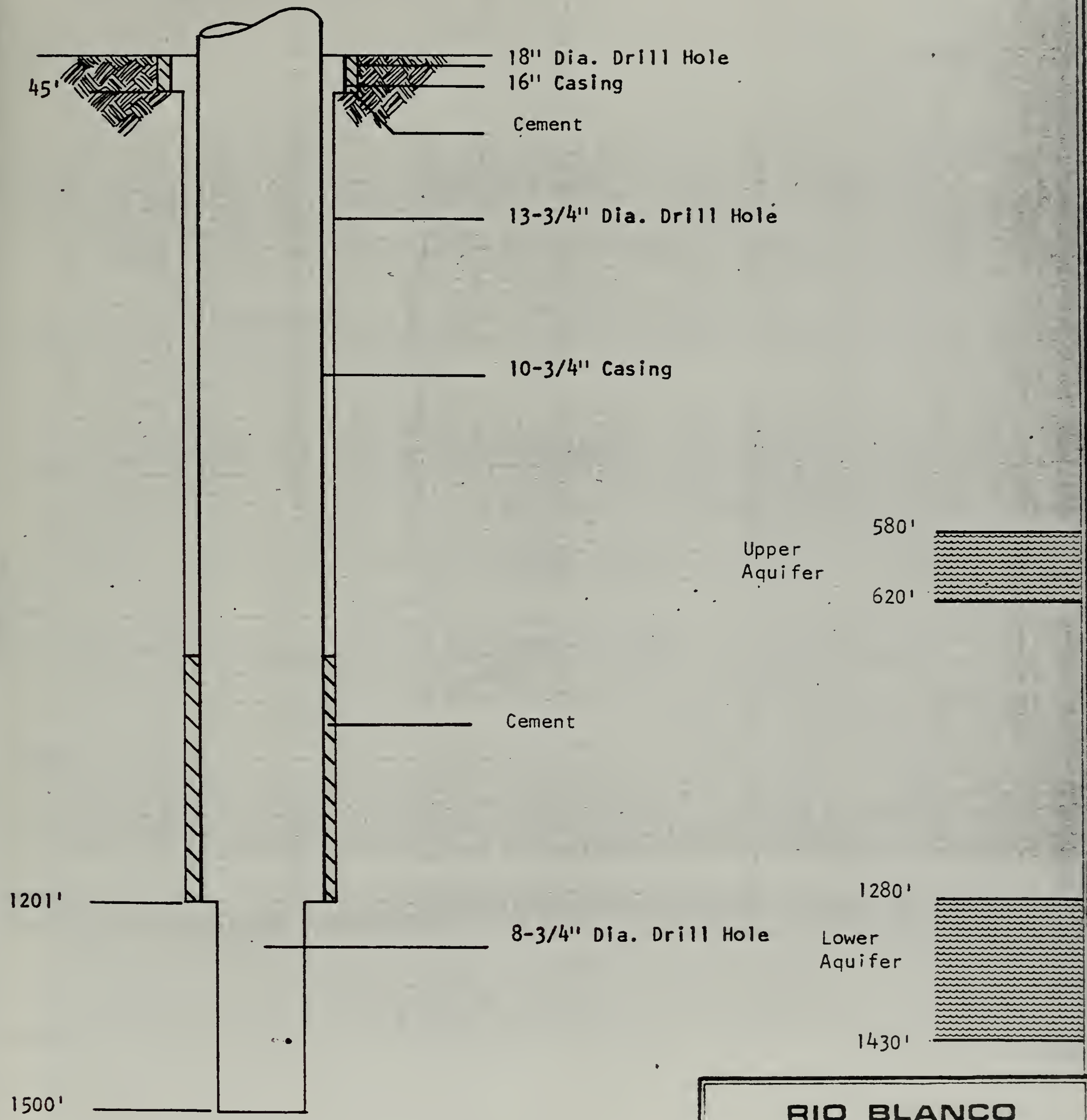


FIG. 2

KEUFFEL & ESSER CO.



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-D-16 DEPTH 1500
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

GS-D-17

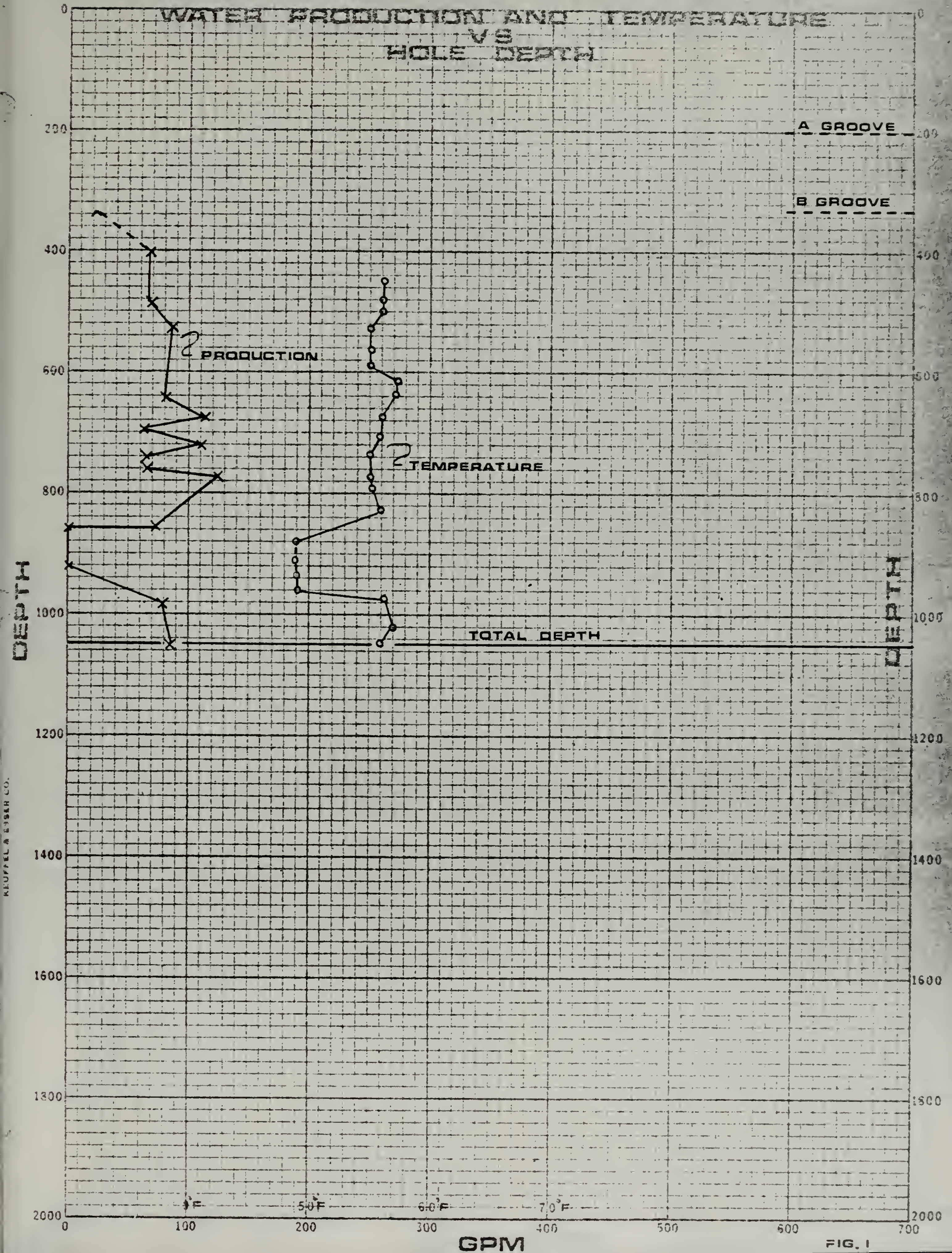
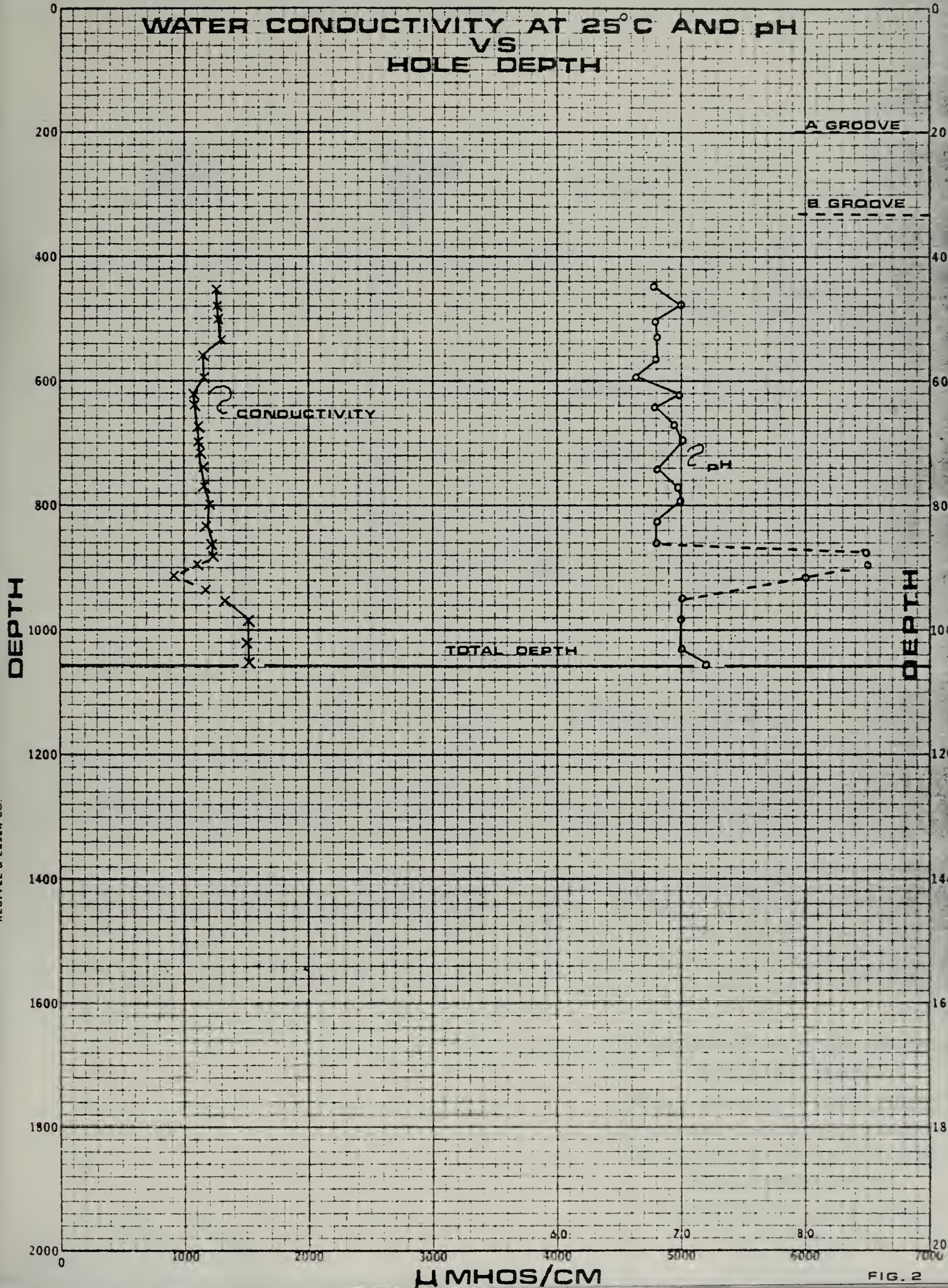


FIG. 1

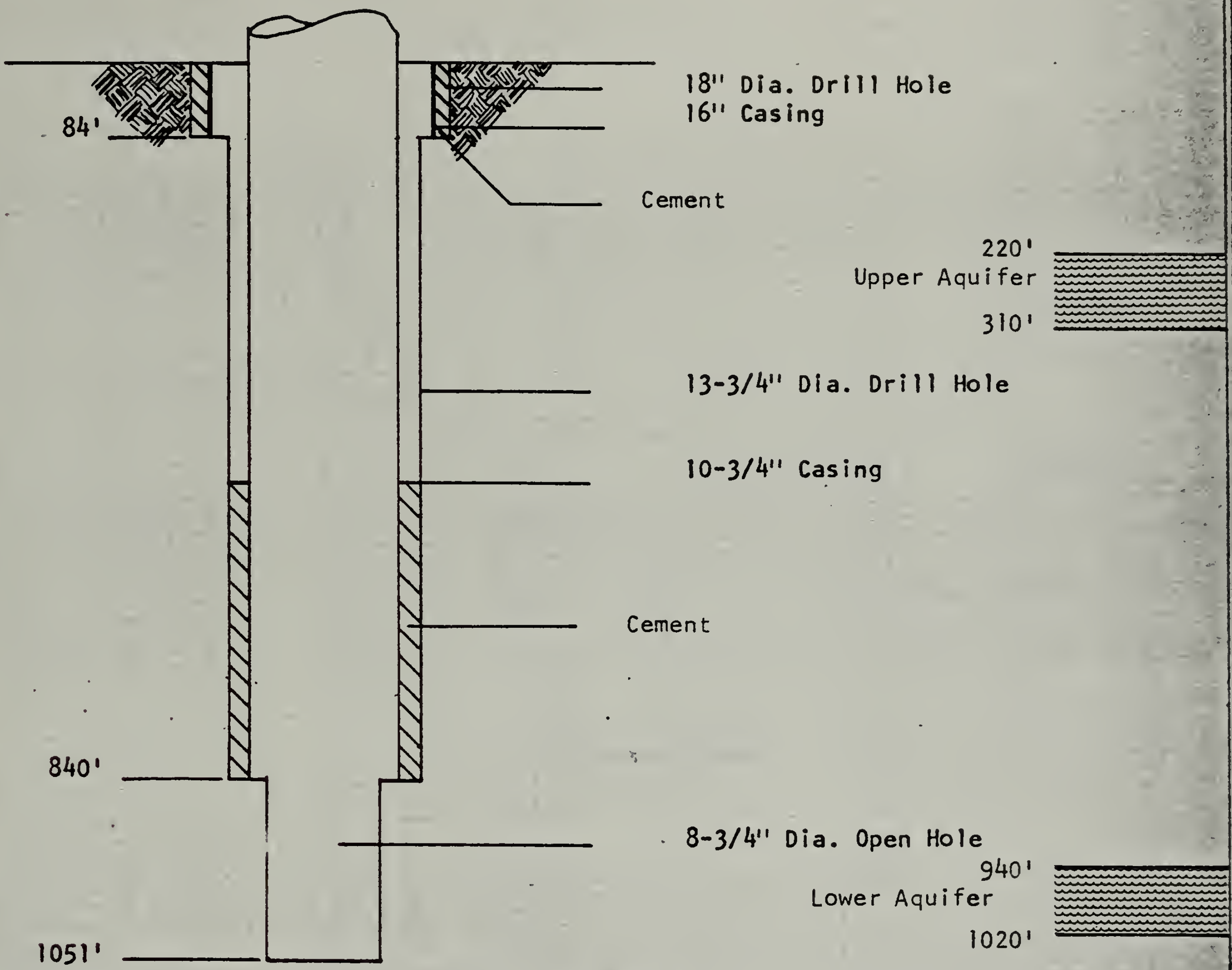
KEUFFEL & ESSER CO.



WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH

FIG. 2

K&E 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



VERITICAL SCALE 1"-200'

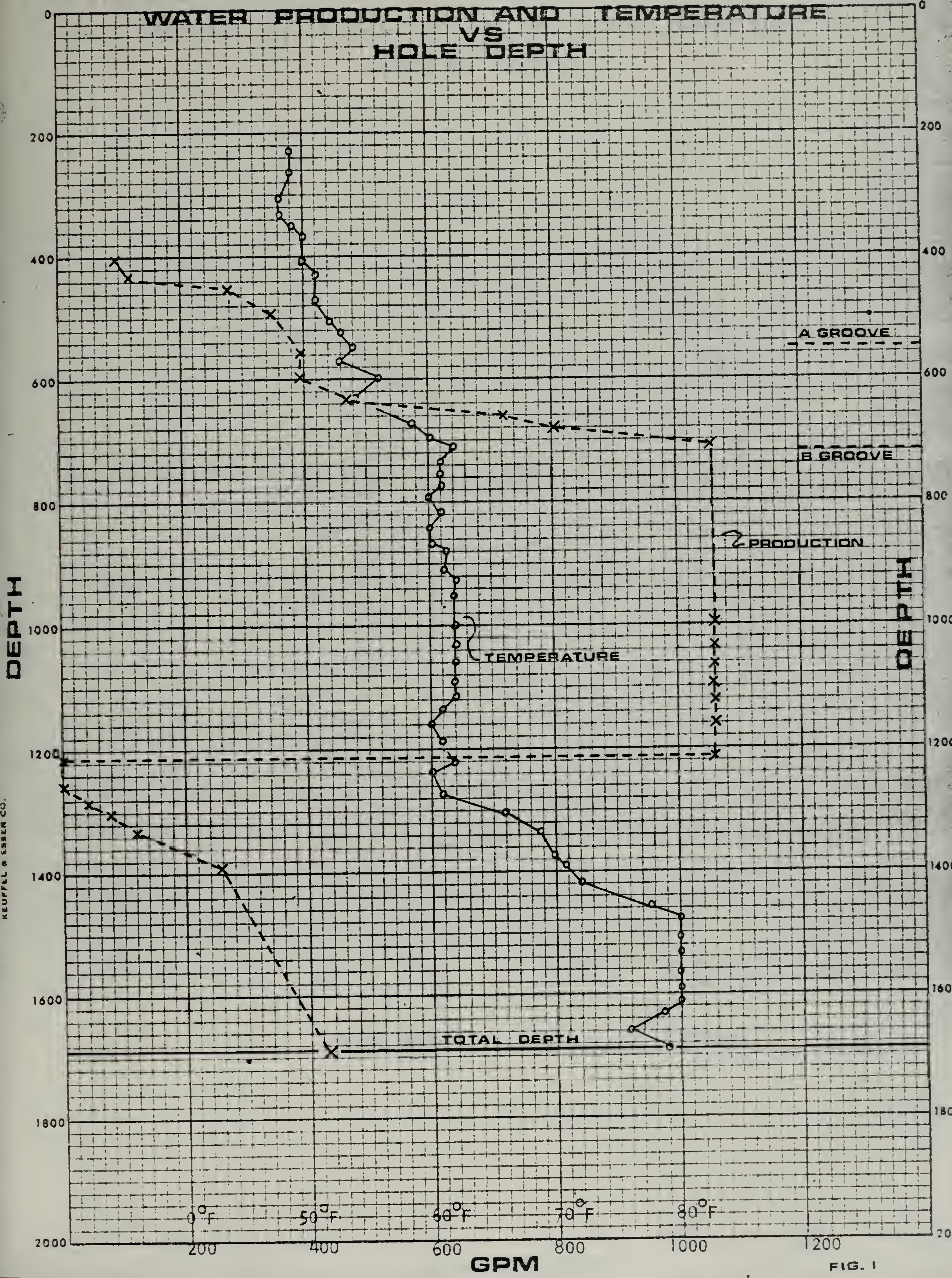
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

RIO BLANCO
OIL SHALE PROJECT

HOLE GS-D-17 DEPTH 1051
DECEMBER, 1974

WRIGHT WATER ENGINEERS, INC.
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211



WATER PRODUCTION AND TEMPERATURE VS HOLE DEPTH

FIG. 1

K&E 7 X 10 INCHES MADE IN U.S.A. KEUFFEL & ESSER CO.

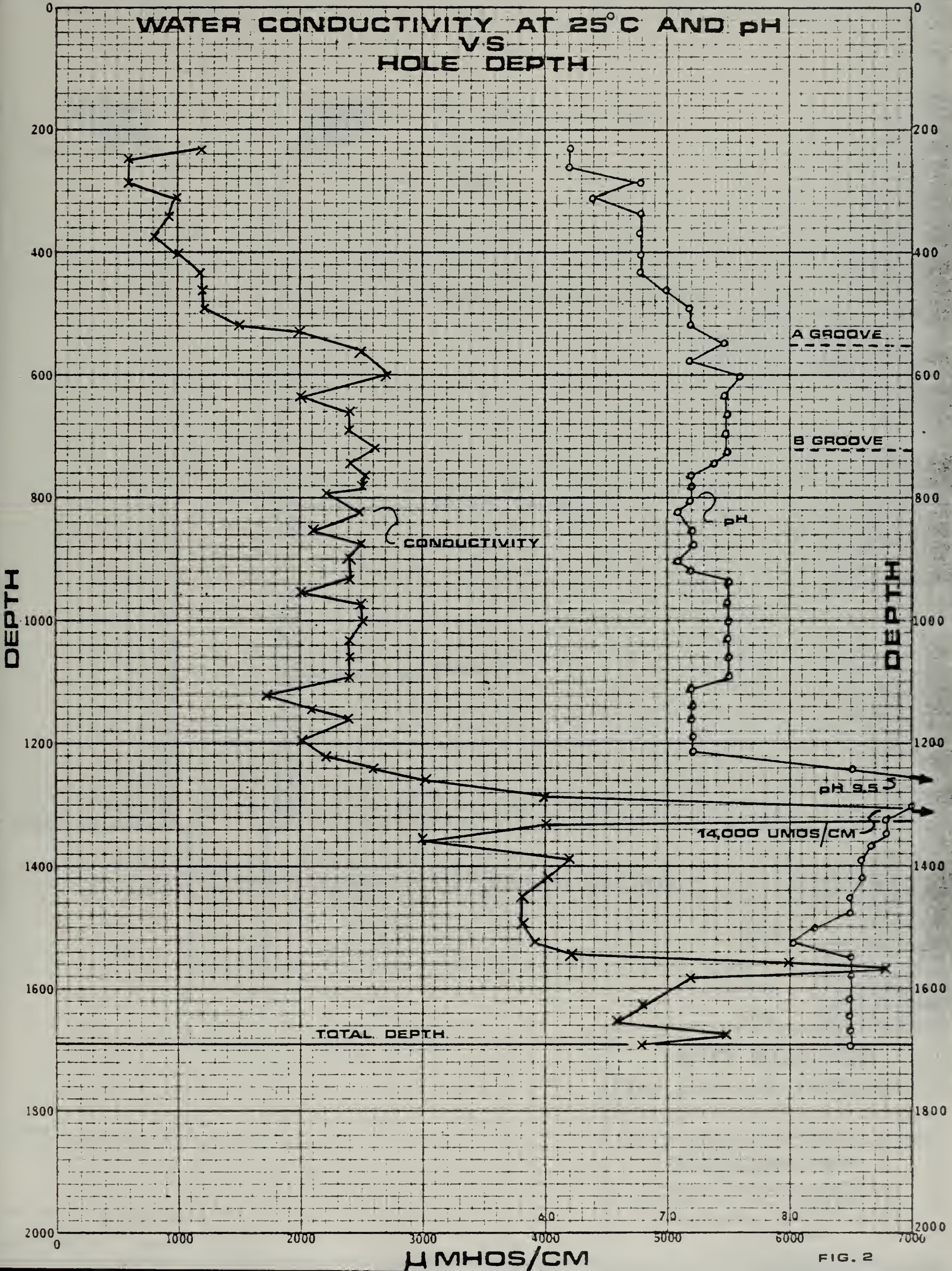
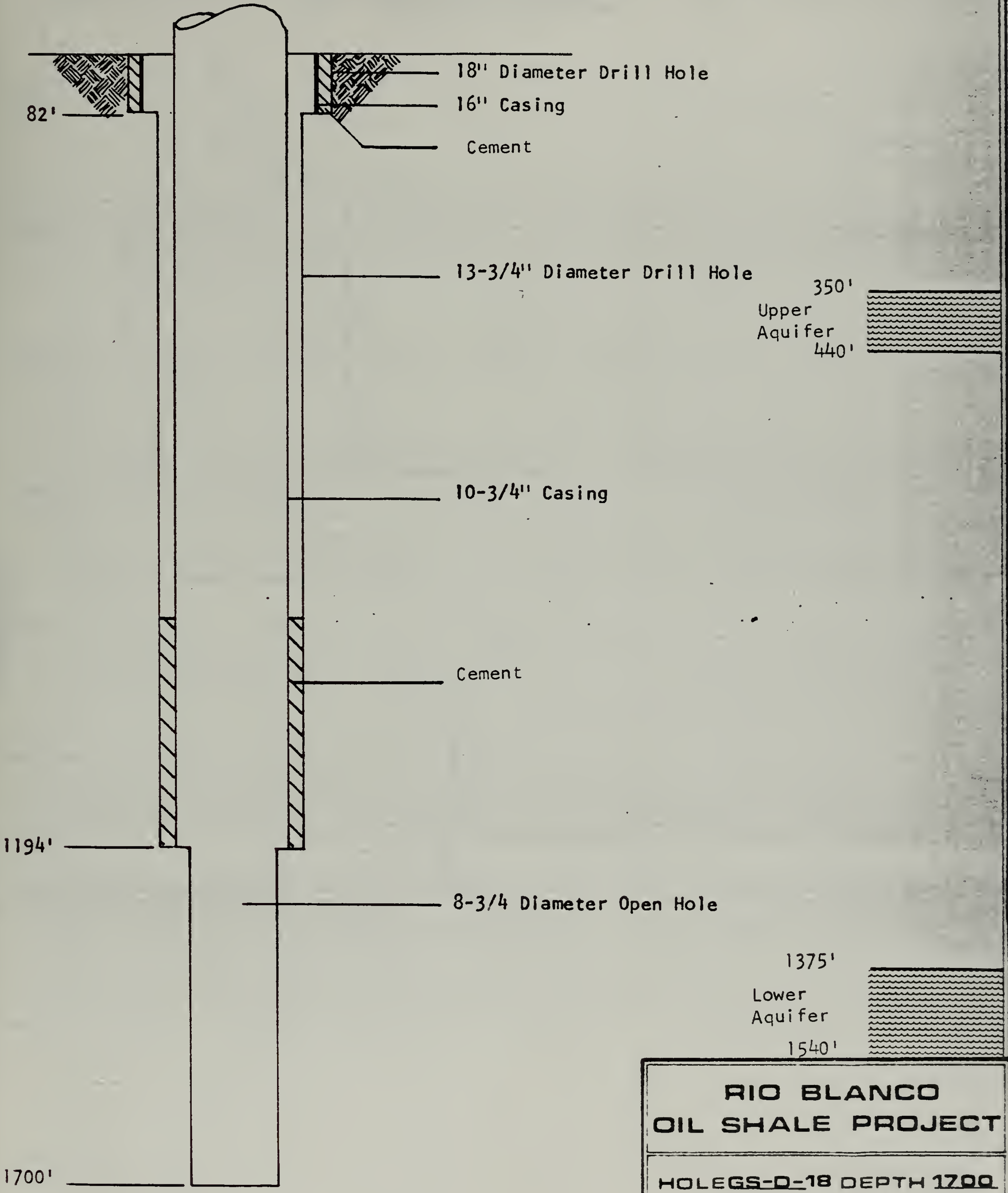

WATER CONDUCTIVITY AT 25°C AND pH VS HOLE DEPTH

FIG. 2

7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.



**RIO BLANCO
OIL SHALE PROJECT**

**HOLEGS-D-18 DEPTH 1700
DECEMBER, 1974**

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
2420 ALCOTT STREET
DENVER COLORADO 80211

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

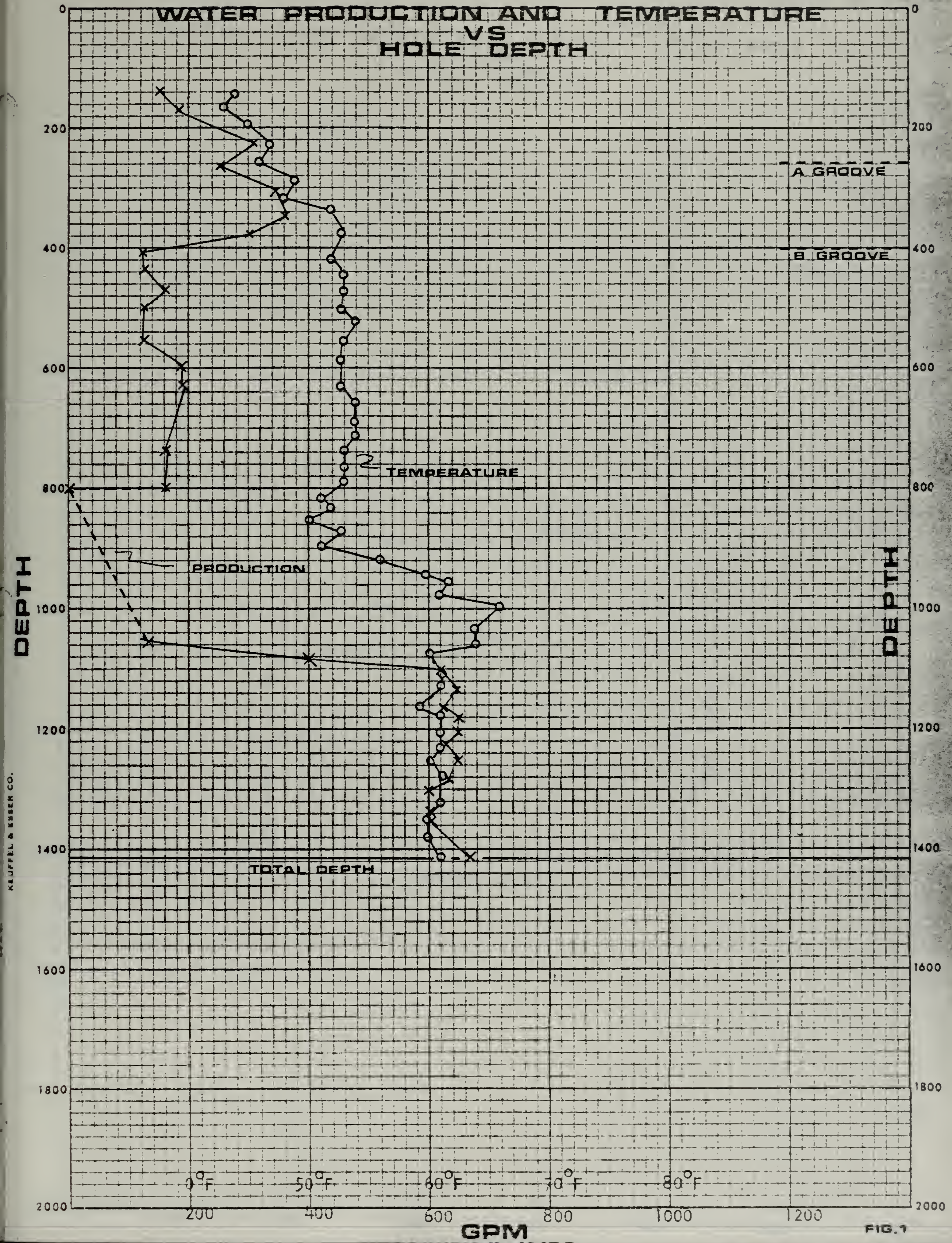
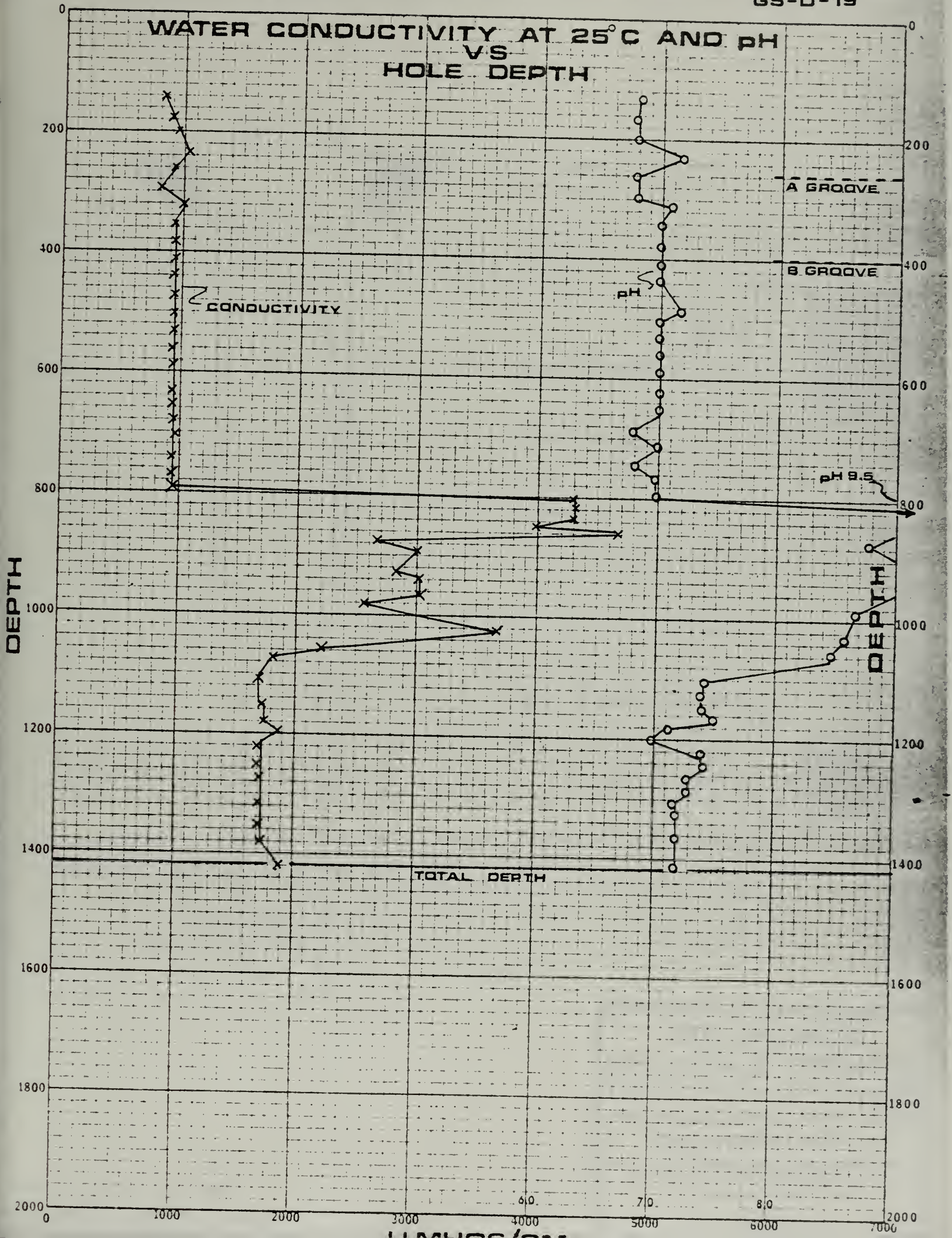
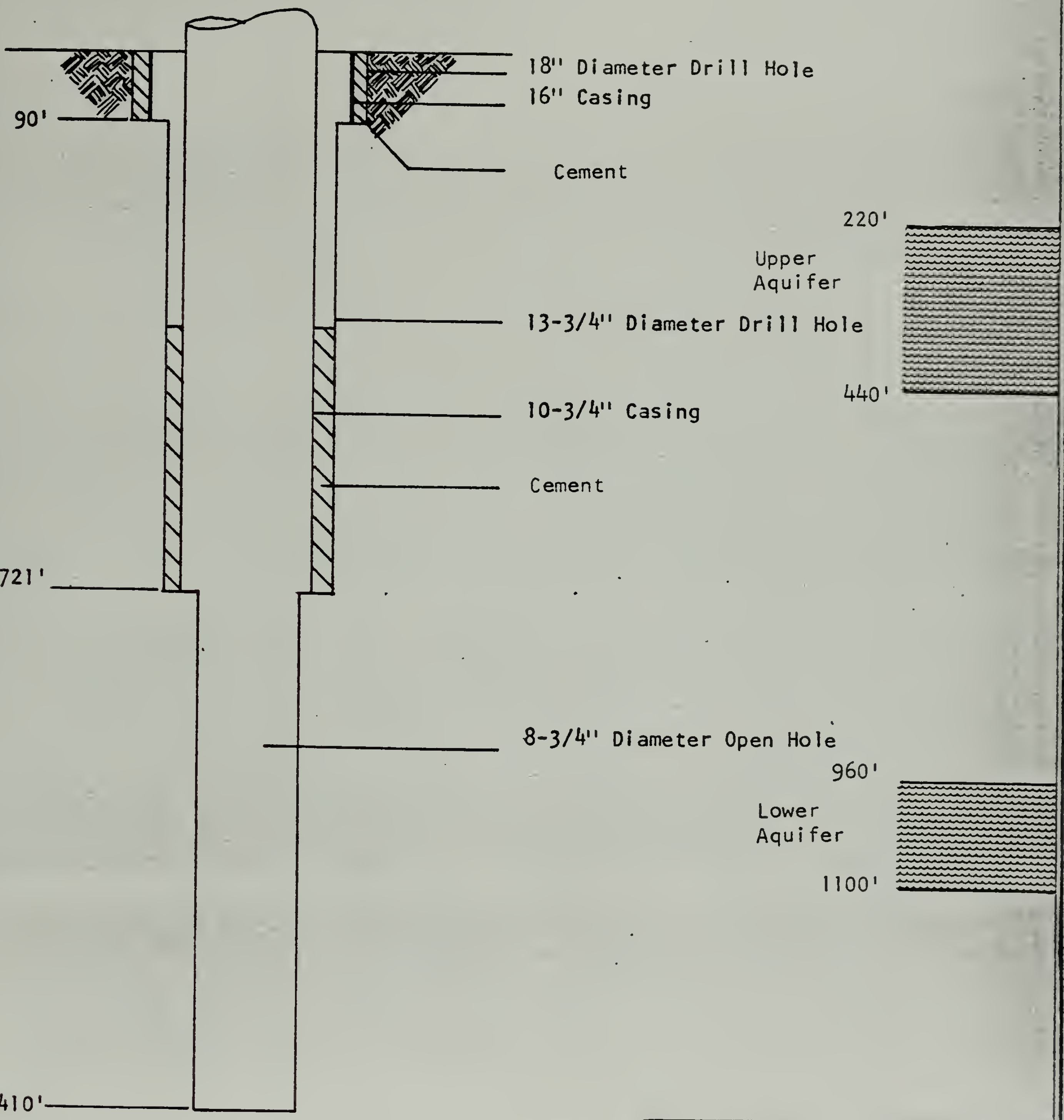

WATER PRODUCTION AND TEMPERATURE
VS
HOLE DEPTH
DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
A GROOVE
B GROOVE
TEMPERATURE
PRODUCTION
TOTAL DEPTH
0°F
50°F
60°F
70°F
80°F
200
400
600
800
1000
1200
GPM
KEUFFEL & ESSER CO.

FIG.1

GS-D-19


WATER CONDUCTIVITY AT 25°C AND pH
VS
HOLE DEPTH
DEPTH
DEPTH
CONDUCTIVITY
pH
pH 9.5
A GROOVE
B GROOVE
TOTAL DEPTH
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
1000
2000
3000
4000
5000
6000
7000
6.0
7.0
8.0



RIO BLANCO
OIL SHALE PROJECT

HOLE GS-D-19 DEPTH 1410
DECEMBER, 1974

WRIGHT WATER ENGINEERS INC
ENGINEERING CONSULTANTS
3420 ALCOTT STREET
DENVER COLORADO 8021

VERITICAL SCALE 1"-200'
HORIZONTAL SCALE 1"-1'-0"

FIG. 7

PROGRESS REPORT 2

GEOTECHNICAL DATA GATHERING PROJECT
HYDROLOGIC PROGRAM
SECTION 1.2

APPENDIX A

APRIL 15, 1975

TO

AREA OIL SHALE SUPERVISOR
UNITED STATES GEOLOGICAL SURVEY

By

WRIGHT WATER ENGINEERS, INC.
For
Gulf Oil Corporation
and
Standard Oil Company (Indiana)

SUMMARY AND BASIC DATA

SHALLOW GROUNDWATER PROGRAM
SEVEN ALLUVIAL TEST WELLS
FEDERAL OIL SHALE TRACT C-a
RIO BLANCO COUNTY, COLOARDO

for

RIO BLANCO OIL SHALE PROJECT
Gulf-Standard (Indiana)

by

Cameron Engineers, Inc.

December 16, 1974

RBOSP PROGRESS REPORT

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HOLE LOCATIONS 1
DRILLING METHOD 3
WELL CONSTRUCTION 4
ALLUVIUM 5
TEST WELLS 7
AQUIFER TESTING 7
WATER QUALITY 11
CONCLUSIONS AND RECOMMENDATIONS 12

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Figure 2 General Construction of Test Wells 6
Figure 3 Graph of Aquifer Test Data, S-7 9

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Table 2 Aquifer Test Data, S-7 10

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Cuttings Description S-6 B
Cuttings Description S-7 C
Cuttings Description S-8 D
Cuttings Description S-11 E
Cuttings Description S-12 F
Cuttings Description S-13 G
Cuttings Description S-14 H

INTRODUCTION

In preparation for the construction of the seven alluvial test wells on and near Federal Oil Shale Tract C-a, Mr. Russell Darr, Wright Water Engineers, Inc. engaged Becker Drills, to drill the holes. Twelve hundred feet of 2-inch I.D. plastic pipe was ordered from Reeves Plastic Pipe Company of Denver. Reeves Plastic also perforated 400 feet of the pipe.

Drilling began on December 3, 1974, and was completed on December 5, 1974. Several more days were necessary for surface construction and for final monitoring of the seven holes. A daily work (drilling) report is included as Appendix A.

SHALLOW HOLE PROGRAM

Location

An index map showing the locations of the 5 on-tract test wells and the 2 off-tract test wells is included as Figure 1. The alluvial test wells and written location descriptions are listed in the order of drilling as follows:

S-6	NE1/4 SE1/4 NW1/4	Sec. 32, T.1S., R.99W
S-7	SW1/4 SE1/4 NW1/4	Sec. 5, T.2S., R.99W
S-8	SW1/4 SE1/4 NE1/4	Sec. 8, T.2S., R.99W
S-14	NW1/4 SE1/4 SE1/4	Sec. 34, T.1S., R.99W
S-13	NE1/4 SW1/4 SE1/4	Sec. 12, T.2S., R.99W

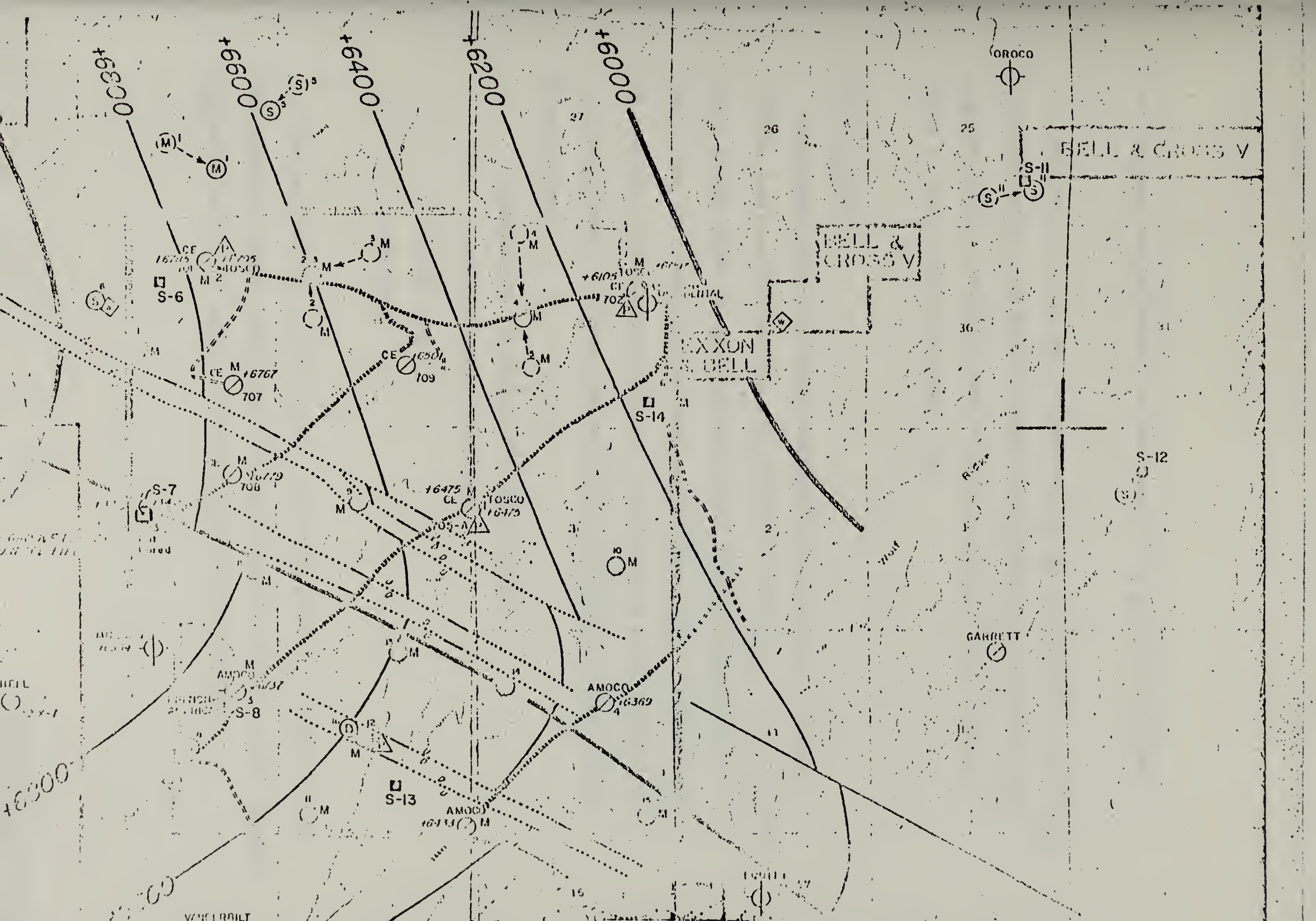


FIGURE I

INDEX MAP SHOWING LOCATIONS OF SHALLOW TEST WELLS

The locations are preliminary as they have not as yet been surveyed.

Locations S-6, S-7, and S-8 were drilled as staked by Mr. Russell Darr. The locations for S-14 and S-11 were given verbally by Mr. Darr. The locations for S-13 and S-12 were visited and located by Mr. Darr and Ernest W. Bond, Cameron Engineers, Inc.

Drilling Method

The Becker Hammer Method was employed using Becker 5-1/2" OD by 3-1/4"ID double-wall drive pipe and reverse air circulation. This method uses a diesel hammer to drive the drill-pipe into the ground, air is forced down the annulus of the double-walled drive pipe. The air lifts the cuttings up through the center of the drive pipe and discharges into a cyclone assembly. Samples can be obtained continuously from the base of the cyclone.

Personnel of the Becker drilling crew were:

Joseph A. DeLuca (Driller)
Melvin King
Bob Scott

The advantage of using the Becker Hammer Method in any application is the recovery of clean, continuous geological samples free of up hole cuttings contamination that is common to conventional drilling methods.

There were, however, disadvantages noted in using the Becker Hammer Method for constructing wells in the alluvial material. Some of the alluvial material was so soft that the weight of the hammer forced the drive pipe into the strata resulting in little or no sample return. Also, some of the material was so soft that the diesel hammer would not start.

It was also noted that the drill pipe did not always clean out and upon beginning a new hole, the first sample returns would contain some of the bedrock material from the previous hole.

In hole S-12, on Stake Springs Draw, a wet clay was encountered that plugged the drive pipe. Water had to be circulated to clean out the pipe.

Perhaps the most severe problem was that, with the exception of well S-7, no water would come out of the hole. During drilling, wet zones were encountered that did not produce water at the time. When total depth was reached and the hole was left standing for a while, there was still no water production. Consequently, only one aquifer test, which is described later, could be conducted.

Well Construction

The drilling log of each of the seven test wells is included in the appendices. Each well was drilled at least five feet into bedrock. Plastic casing, 2-inch ID PVC, was installed in each hole. Perforated pipe was installed first with a short length of non-perforated pipe at

the top. Reeves Plastic Pipe Company perforated the pipe by making band saw cuts about 1/4 the way through the pipe in four places per foot. The casing record is included with each log in the appendices.

Once the plastic pipe was installed, the annulus was backfilled with material at least as permeable as the strata in the hole. Holes S-6, S-7, and S-8 were backfilled with gravelly material taken from the hydrologic drill site at location CE-705A, and the rest of the holes were backfilled with Uinta Formation talus.

To protect the well at the surface, 6 feet of 4-1/2" steel casing was cemented at the surface. Caps were made by welding a plate inside 4-1/2-inch thread protectors. The sides of the thread protectors were slit in two places to allow a friction fit.

The general construction used for each test well is shown in Figure 2.

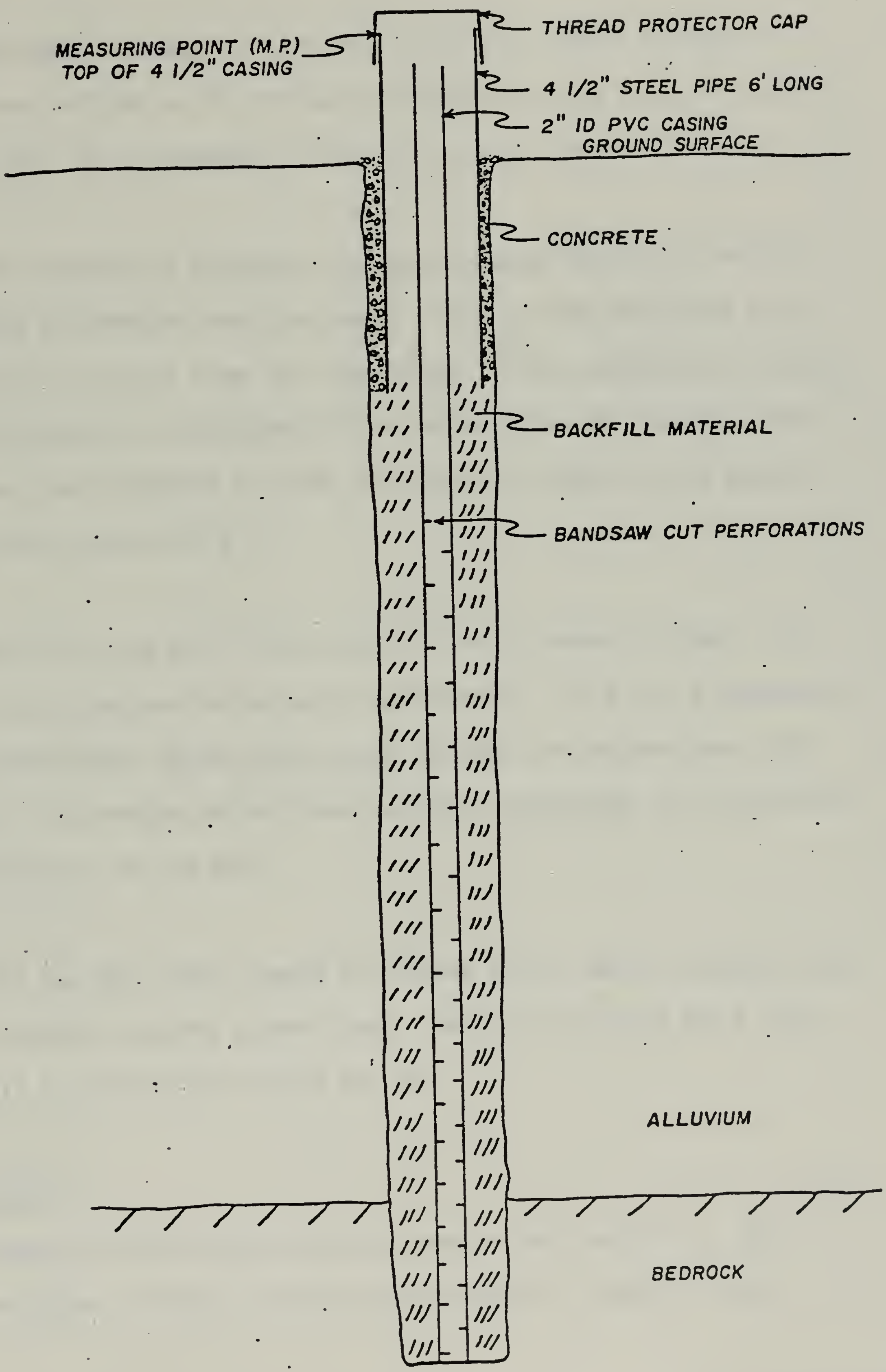
Alluvium

The alluvium is poorly developed in the upper reaches of the streams near the west end of Tract C-a. The unconsolidated material in Dry Fork, in which S-6 is located, consists mostly of slope wash and fan material at tributary mouths. On Corral Gulch fairly well developed alluvium begins just downstream from CE-708. On Box Elder Gulch, the developed alluvium extends downstream from the vicinity of CE-705-a. The developed alluvium in "Rinky Dink Gulch" only extends upstream from its mouth about 1/2 mile.

FIGURE 2

GENERAL CONSTRUCTION OF TEST WELLS

NOT TO SCALE



Test Wells

The physical parameters of the test wells are listed in Table 1. The wells were drilled in the following order: S-6, S-7, S-8, S-14, S-13, S-11, and S-12. As of December 9, 1974, S-6, S-13, and S-14 are dry.

Table 1 indicates a difference between measured depth and drilled depth. These differences have two causes. One is that the drive pipe used in drilling did not clean out completely. Fine powdered clay stayed in the drill pipe until dislodged by the installation of the PVC casing. The drilling crew attempted to clean out the drive pipe in each case by probing, then surging with air.

In hole S-12, the hole filled from 87 feet to about 43 feet. In this case, the cause was the material encountered. In S-12, a saturated clay was encountered, which easily moved through the perforations into the casing. The problem in this case was also compounded by circulating water in this area of the hole.

Each of the test wells should be cleaned out by using a garden hose or small diameter pipe and a water pump. Using an air hose and a relatively small air compressor may do the job.

Aquifer Testing

An informal recovery test was conducted on test well S-7. The results are shown in Figure 3 and the data listed in Table 2. The

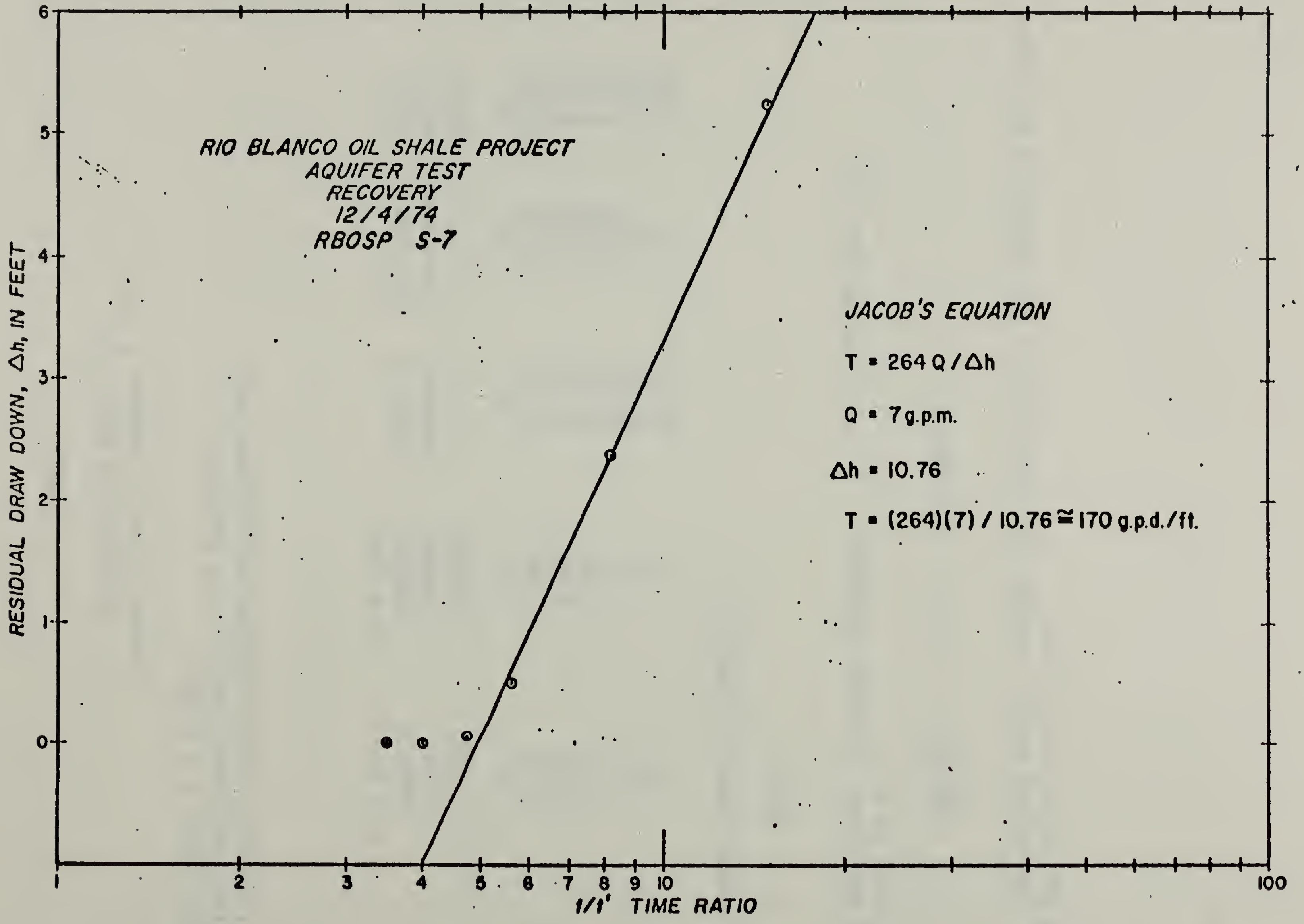
TABLE 1

Summary of physical measurements taken in the field. The test wells are listed by numerical well number rather than in chronological order of measurement.

Test Well	Drilled Depth (ft.)	Depth of Base of Alluvium (ft.)	Casing Record 2" ID PVC		Water Level Below MP (ft.)	MP From Ground Surface (ft.)	Depth Water From Ground Surface (ft.)	Measured Depth of Hole Ground Surface (ft.)	Date Measured	Time Measured
			Non-perforated (ft.)	Perforated (ft.)						
S-6	12	8	5.5	8.5	Dry	2.75	Dry	10.7	12/8/74	3:00 PM
S-7	44	39	14.5	31.5	24.52	2.25	22.27	38.9	12/8/74	3:30 PM
S-8	50	45	12	40	40.16	2.20	37.96	45.9	12/8/74	4:10 PM
S-11	66	59	8	60	47.18	2.70	44.48	58.7	12/9/74	12:30 PM
S-12	87	81	29	60	34.79	2.60	32.19	43.3	12/9/74	8:00 AM
S-13	28	22	10	20	Dry	2.20	Dry	25.8	12/9/74	9:30 AM
S-14	50	44	12	40	Dry	2.35	Dry	48.8	12/9/74	10:00 AM

RBOSP PROGRESS REPORT

FIGURE 3
GRAPH OF AQUIFER TEST DATA, S-7



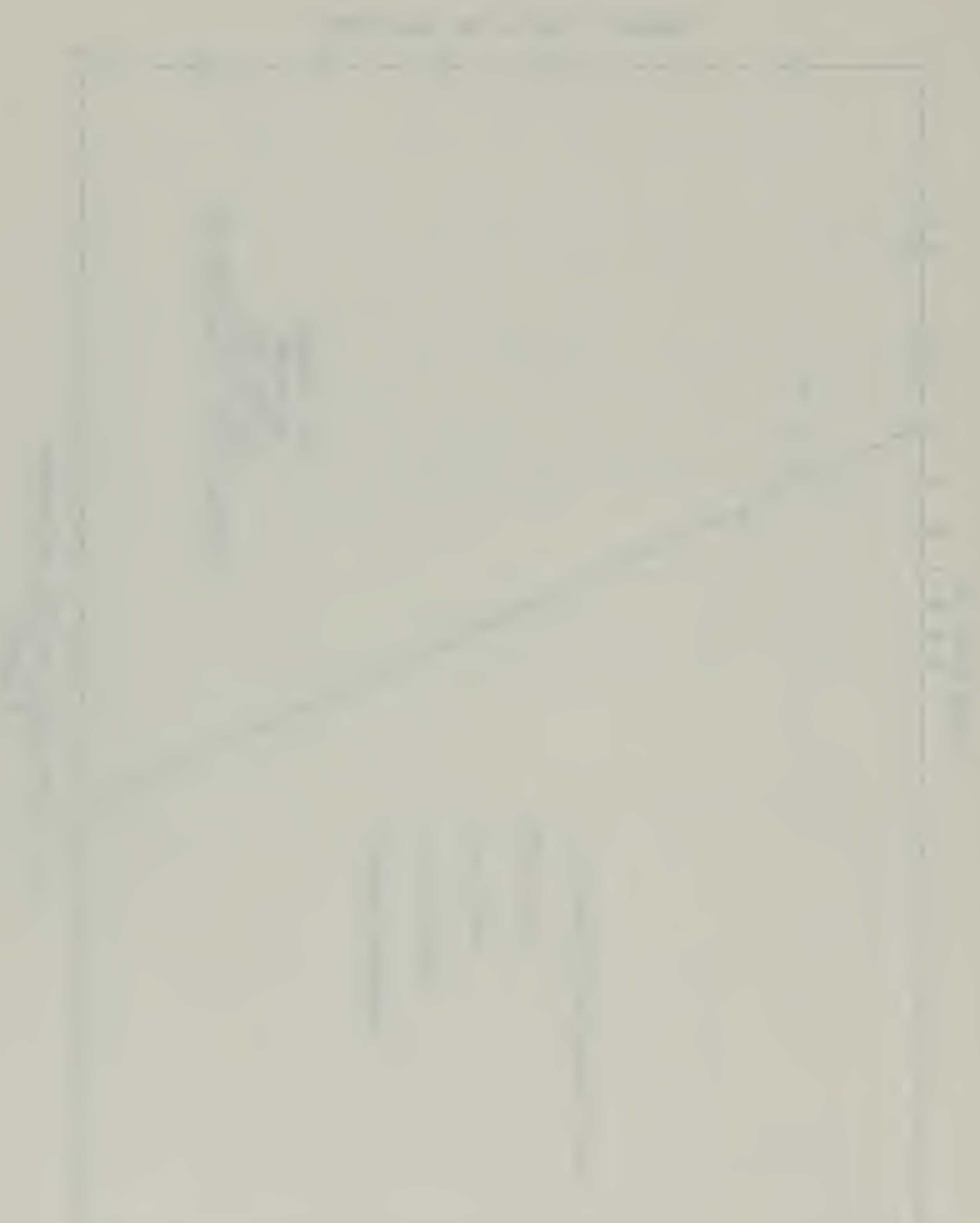


TABLE 2

Aquifer Test Data, S-7.
Recovery Test, December 4, 1974

Pumping Rate, Q = 7 gpm.
Static Water Level, SWL = 24.77 feet/MP*
T = Transmissivity in gallons per day per foot.

Time since pumping began t' (min)	Time since pumping stopped t' (min)	Depth to Water/MP h	Residual Drawdown h	Time Ratio t/t'
15	-0-	-0-	-0-	-0-
16.08	1.08	30.00	5.23	14.89
17.08	2.08	27.15	2.38	8.21
18.25	3.25	25.27	0.50	5.62
19	4	24.83	0.06	4.75
20	5	24.77	-0-	4.00
21	6	24.77	-0-	3.50

The Common Jacobs' Equation

$$T = \frac{264\ Q}{h}$$

From the graph, residual drawdown, h = 10.76 ft/MP over one log cycle of t/t'.

$$T = \frac{(264)(7)}{10.76} = 171.7 = 170 \text{ gpd/ft.}$$

*MP - Measuring Point. During the recovery test the measuring point was the top of the drill pipe.

transmissivity of 170 gallons per day per foot of aquifer width (gpd/ft) may be a little low, but it does indicate the low permeability of the unconsolidated material.

Aquifer tests were not conducted on any of the other test wells because there was no water production during drilling or while the drilling equipment was on location.

Aquifer tests can be conducted on the other test wells if the wells first are cleaned out. Ater the well has been cleaned out and left standing long enough for the aquifer to stabilize, the well can be tested by the slug injection method or by the bailing method. Information on these methods can be obtained by personal communication with the writer or consulting texts on Hydrogeology.

Water Quality

Because S-7 was the only well with water production at the time of drilling, this was the only well sampled. The sample will be given to Mr. Russell Darr, Wright Water Engineers, Inc., upon submission of this report.

Water temperatures in S-7 was 10°C. The specific conductivity as measured in the field was 840 uMhos/cm @ 10°C (1300 uMhos/cm @ 25°C).

The other test wells that contain water can be sampled by fashioning a dip-sampler from conduit or other small diameter pipe. If the samples are to be analyzed for trace elements the sampling vessel should be made of plastic and the sample filtered at the time it is taken.

Conclusions and Recommendations

Seven shallow, alluvial test wells were drilled and completed as instructed by Mr. Russell Darr, Wright Water Engineers, Inc., consultant to Rio Blanco Oil Shale Project.

All the test wells should be cleaned by using either air or water circulation.

A dip sampler should be constructed consistent with the water quality analyses desired and used for the periodic water quality sampling.

At first, the water levels should be measured once a week. Later, once each month may be enough. The water levels should be monitored more often during the spring months.

There are 42 joints of 2-inch PVC left on the pipe rack at location C-6. It is recommended that this pipe be kept for future use in drilling shallow test wells on and near spent shale and overburden disposal sites.

APPENDIX B

CUTTINGS DESCRIPTION

RBOSP S-6

RIO BLANCO OIL SHALE PROJECT

CUTTINGS DESCRIPTION

S-6

Location:	NE-1/4 SE-1/4 NW-1/4 Sec. 32, T1S, R99W. By pacing S-6 is 543 feet downstream from the cement flume at the gauging station on the north side of the stream channel.
Spudded:	December 3, 1974
Completed:	December 3, 1974
Total Depth:	12 feet

0' - 2'
Soil, silt, sand, and gravel; sand is fine, a few walnut-sized rocks, gravel and rocks, some are rounded, some broken, rocks are composed of both marlstone and schist.

2' - 4'
Sand and silt, silt size to fine sand, brown to brownish black, some gravel, rounded, some broken, with a few larger pebbles.

4' - 6'
Silt, sand, and gravel, brown and black colored, well mixed, larger pieces broken.

6' - 8'
Clay and silt, yellow, a few chert pebbles.

8' - 12'
Oil shale, varved, kerogenous marlstone.

Summary: 0' - 8' Alluvium
8' - 12' Parachute Creek Member

Casing Record:
2 inch ID PVC
8.5 feet perforated
5.5 feet plain

Comments: At time of drilling, the hole was dry.

APPENDIX C

CUTTINGS DESCRIPTION

RBOSP S-7

Alluvial Test
December 3, 1974
Job 431-74

RIO BLANCO OIL SHALE PROJECT

CUTTINGS DESCRIPTION

S-7

Location:	SW-1/4 SE-1/4 NW-1/4 Sec. 5, T2S, R99W. By pacing, S-7 is 321 feet along the road to the weir at gauging station.
Spudded:	December 3, 1974
Completed:	December 4, 1974
Total Depth:	44 feet

0' - 2'
Clay and silt, yellow, a few pebbles of oil shale, some gravel.

2' - 4'
Clay and silt, yellow, with more oil shale fragments, and more rounded gravel.

4' - 6'
Clay and silt, yellow, a few oil shale fragments

6' - 8'
Clay and silt, yellow, large fragments of oil shale, gravel, some well rounded, some broken.

8' - 10'
Clay and silt, yellow, clay and siltstone lumps, oil shale fragments.

10' - 12'
Clay and silt, tan, large oil shale fragments, plant roots, gravel, some fractured, some rounded.

12' - 14'
Clay and silt, tan, gravel, a few rounded siltstone and claystone balls that look like gravel.

14' - 16'
Clay and silt, tan, gravel with a few chert pebbles, and rounded claystone and siltstone balls.

16' - 24'
Clay and silt, tan, some clay and siltstone lumps.

24' - 26'
Clay and silt, tan, some clay and siltstone lumps, a few chert pebbles.

26' - 28'
As above with a few limey fragments.

28' - 30'
Sand, fine, clay and silt, yellowish tan, some small gravel.

30' - 39'
Clay, oil shale fragments, siltstone, yellow, fragmented, samples are wet. Most water in the hole is from 38-39 feet.

39' - 44'
Oil shale, kerogenous marlstone.

Summary:
0' - 12' Roadfill
12' - 39' Alluvium
39' - 44' Parachute Creek Member

Casing record:
2 inch ID PVC
31.5 feet perforated
14.5 feet plain

Comments: Samples became wet at 30 feet. The most water came into the hole at the bottom of the alluvium, 38-39 feet. Hydrologic testing was conducted 12/4/74.

APPENDIX D

CUTTINGS DESCRIPTION

RBOSP S-8

Alluvial Test
December 4, 1974
Job 431-74

RIO BLANCO OIL SHALE PROJECT

CUTTINGS DESCRIPTION

S-8

Location:	SW-1/4 SE-1/4 NE-1/4 Sec. 8, T2S, R99W. By pacing, S-8 is 588 feet along the road upstream from AMOCO 3, and 737 feet along the road downstream from the gauging station.
Spudded:	December 4, 1974
Completed:	December 4, 1974
Total Depth:	50 feet

0' - 2'
Topsoil and clay, brown, moist, some small gravel, chert and marlstone.

2' - 4'
Clay, brown, moist, somewhat organic as a soil, poor returns.

4' - 6'
Clay, brown, dry, somewhat organic.

6' - 8'
Clay, light brown, dry, some marlstone gravel.

8' - 16'
Clay and silt, light brown, powdery dry, some marlstone gravel.

16' - 18'
Clay and silt, light brown, powdery dry, less marlstone gravel.

18' - 20'
Siltstone, whitish-yellow, clay, light brown, powdery dry.

20' - 24'
Clay, light brown, powdery dry, some siltstone as above. 20'-22' poor returns, 22'-24' better returns.

24' - 26'
Clay, light brown, lumpy, limonite inclusions, clay, light brown, powdery dry, siltstone, whitish-yellow, fragmented.

26' - 30'
Siltstone, whitish-yellow, gray, and rusty, clay, light brown and powdery.

30' - 32'
Clay, light brown, lumpy, limonite inclusions, siltstone, whitish-yellow and gray, clay, light brown and powdery, rather poor returns.

32' - 38'
Clay, light brown, powdery dry, clay, light brown, lumpy, limonite inclusions, siltstone, whitish-yellow and gray, a few moist clay lumps.

38' - 40'
Clay, light brown, lumpy, limonite inclusions, some siltstone and powdery clay.

40' - 42'
Clay, light brown, a touch moist-not as powdery, some marlstone fragments.

42' - 44'
Clay, light brown, siltstone, streaked gray, blue and rusty, this stratum is a little harder, which resulted in better returns.

44' - 46'
Clay, light brown, oil shale, fractured fragments, some siltstone.

46' - 50'
Oil shale, kerogenous marlstone, some leftover light brown clay. Oil shale started at 45 feet.

Summary: 0' - 45' Colluvium and Alluvium
45' - 50' Parachute Creek Member

Casing Record:
2 inch ID PVC
40 feet perforated
12 feet plain

Comments: At the time of drilling, the hole was dry.

APPENDIX E

CUTTINGS DESCRIPTION

RBOSP S-11

Alluvial Test
December 5, 1974
Job 431-74

RIO BLANCO OIL SHALE PROJECT

CUTTINGS DESCRIPTION

S-11

Location: NW-1/4 SE-1/4 SE-1/4 Sec. 25, T1S, R99W. By pacing, S-11 is 53 feet from the old windmill, and 522 feet downstream from north end of the dam.
Spudded: December 5, 1974
Completed: December 5, 1974
Total Depth: 66 feet

0' - 4'
Topsoil, clay, light brown, powdery, leftover oil shale fragments.

4' - 12'
Clay, light brown, powdery, plant roots.

12' - 24'
Clay, light brown, powdery, clay lumps and darker brown banded clay and silt fragments, soft. 16'-20' poor return, 20'-24' fewer clay lumps.

24' - 32'
Clay, light brown, powdery, a few small dark brown lumps with limonite inclusions, a few small chips marlstone.

32' - 36'
Clay, light brown, powdery, a few brown clay lumps, rock fragments, hard, and a few fragments marlstone.

36' - 40'
Clay, light brown, powdery, clay, brown, lumps, limonite inclusions, poor sample return.

40' - 44'
As above with small white flecks, and hard rock fragments.

44' - 48'
Clay, brown, wet, clay, brown, lumps, limonite inclusions, a few small rock fragments. Water seep 46'-48'.

48' - 52'
As above, not as wet, no rock fragments.

52' - 56'
Clay, brown, wet, clay, light brown, powdery dry, a few marlstone fragments.

56' - 60'
Clay, brown, just moist, sandstone, silty, a few hard fragments - Bedrock at 59 feet.

60' - 64'
Siltstone, gray, a little sandy (very fine), clay, brown lumps, and clay, light brown, silty.

64' - 66'
Siltstone, gray to green, sandy, grinds to gray powder.

Summary: 0' - 59' Alluvium
59' - 66' Uinta Formation

Casing Record:
2 inch ID PVC
60 feet perforated
8 feet plain

Comments: No water tests could be conducted because no water was blown out of the hole.

APPENDIX F

CUTTINGS DESCRIPTION

RBOSP S-12

Alluvial Test
December 5, 1974
Job 431-74

RIO BLANCO OIL SHALE PROJECT

CUTTINGS DESCRIPTION

S-12

Location:	NW-1/4 SE-1/4 NW-1/4 Sec. 6, T2S, R98W. S-12 is just two miles by odometer from turn off to 84-ranch up Stake Springs Draw. S-12 is, by pacing, 26 feet north of the north edge of the out coulee. Finally, the distance from S-12 to the Garrett drill hole is 1-1/4 miles. S-12 is downstream from the Garrett hole.
Spudded:	December 5, 1974
Completed:	December 5, 1974
Total Depth:	87 feet

0' - 4'
Topsoil, clay, brown, and silty residue from previous hole (S-11).

4' - 16'
Clay, light brown, powdery dry, somewhat organic as a soil.

16' - 20'
Clay, light brown, powdery, clay, brown lumps with white (salt?) inclusions.

20' - 28'
Clay, brown, lumps, clay, light brown, powdery, poor returns.

28' - 32'
Clay, brown, moist, some is soggy wet, limonite inclusions, some sandy siltstone.

32' - 36'
Clay, brown, soggy wet, some sandy siltstone.

Note: At about 38 feet, the clay was too sticky to continue drilling with air. The crew drilled through the mucky interval using water circulation.

36' - 40'
Clay, brown, white inclusions, siltstone, brown to gray, gravel and sandstone pebbles to 1-1/2".

40' - 48'
Clay, brown, gravel and rock from gravel size to 1-1/2" a few very hard rock fragments.

48' - 52'
Clay, brown.

52' - 56'
Clay, brown, rock fragments 1" to 2".

56' - 64'
Clay, brown, gravel.

64' - 68'
Gravel, flat rocks to 1-1/2", and brown clay.

68' - 72'
Sand, brown, very fine to medium, pebbles to 1/2" by 3/4".

72' - 81'
Gravel and rocks, rocks-2" by 1", looks like float from both the Uinta Formation and the Parachute Creek Member.

81' - 87'
Siltstone, gray, and silty clay.

Summary: 0' - 81' Alluvium
81' - 87' Uinta Formation

Casing Record:
2 inch ID PVC
60 feet perforated
9 feet plain

Comments: Again, could not conduct an aquifer test because the water could not get to the bit area fromthe outside of the drill pipe. Also, evaluation was difficult because the drilling crew had to use water.

APPENDIX G

CUTTINGS DESCRIPTION

RBOSP S-13

Alluvial Test
December 5, 1974
Job 431-74

RIO BLANCO OIL SHALE PROJECT

CUTTINGS DESCRIPTION

S-13

Location:	NE-1/4 SW-1/4 SE-1/4 Sec. 12, T2S, R99W. S-14 is located 0.4 miles down slope from AMOCO 2a.
Spudded:	December 5, 1974
Completed:	December 5, 1974
Total Depth:	28 feet

0' - 8'
Clay, light brown, some lumps, marlstone fragments.

8' - 16'
Clay, light brown to yellow-tan, marlstone, gravel size to 2" across, a few clay lumps.

16' - 22'
Clay, light brown, clay, silty, lumps, limonite inclusions, some marlstone(?).

22' - 28'
Oil shale, kerogenous marlstone, rig grinds much of the oil shale into a light gray powder.

Summary: 0' - 22' Alluvium
22' - 28' Parachute Creek Member

Casing Record:
2 inch ID PVC
20 feet perforated
10 feet plain

Comments: The hole was dry.

APPENDIX H

CUTTINGS DESCRIPTION

RBOSP S-14

Alluvial Test
December 4, 1974
Job 431-74

RIO BLANCO OIL SHALE PROJECT

CUTTINGS DESCRIPTION

S-14

Location: NW-1/4 SE-1/4 SE-1/4 Sec. 34, T1S, R99W. Lower Rinky Dink. By pacing, S-13 is 143 feet up the creek from the center of the recorder shelter at the gauging station and 28 feet east of the creek cut.
Spudded: December 4, 1974
Completed: December 4, 1974
Total Depth: 50 feet

0' - 2'

Topsoil and clay, light brown, powdery, some small white particles, very soft, poor returns.

2' - 6'

Clay, brown, powdery, a few clay lumps with limonite inclusions, plant roots.

6' - 10'

Clay, light brown, powdery, a few clay lumps.

10' - 14'

Clay, light brown, powdery, a few clay lumps, some small gravel of marlstone and some red siltstone.

14' - 22'

Clay, light brown, powdery, a few clay lumps.

22' - 24'

Clay, light brown, powdery, a few clay lumps, a few oil shale fragments.

24' - 28'

Clay, light brown, powdery, clay, brown, lumps, white and rusty streaks.

28' - 32'

Clay, light brown, powdery, clay, brown, lumps, rusty, streaks.

32' - 34'

Clay, light brown, powdery, clay, lumps, streaked rusty, brown and white.

34' - 44'

Clay, lumps, layered brown, light brown, white, clay, light brown, powdery.

44' - 50'
Oil shale, kerogenous marlstone.

Summary: 0' - 44' Alluvium
44' - 50' Parachute Creek Member

Casing Record:
2 inch ID PVC
40 feet perforated
12 feet plain

Comments: At the time of drilling, the hole was dry.

Form 1279-3
(June 1984)

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